Journal of Critical Reviews

ISSN- 2394-5125 Vol 4, Issue 2, 2017

Preemptive Priority Mechanism with Hybrid Spectrum Sensing for Cognitive Radio

Kanaparthy Rajender Prasad[1], Guvvaladinne Prasanna Kumar[2]
Assistant Professor[1,2]
Department of ECE
MREC

Abstract- In order to access the channel the secondary user have to continuously sense the channel which results in large amount of energy wastage. Therefore, in order to overcome this we propose a hybrid sensing mechanism for Secondary User's to access the channel in CRN environment.In the proposed hybrid sensing mechanism the for Secondary User sense the channel periodically when it is used by Primary User while the for Secondary User sense the channel continuously whenever the channel is used by the SU.
Since primary users have higher priority when compared to secondary users, we investigate the role of this hybrid sensing mechanism wherein PUs have a preemptive priority over for Secondary User's in oder to use the spectrum efficiently.

Index Terms- About four key words or phrases in alphabetical order, separated by commas. Keywords are used to retrieve documents in an information system such as an online journal or a search engine. (Mention 4-5 keywords)

I. INTRODUCTION

Cognitive radio (CR) is a form of wireless communication in which atransceivercan intelligently detect which communication channels are in use and which are not, and instantly move into vacant channels while avoiding occupied ones. This optimizes the use of available radio-frequency (RF) spectrum while minimizing interference to other users.In its most basic form, CR is a hybrid technology involving software defined radio (SDR) as applied tospreadspectrumcommunications. Possible functions of cognitive radio include the ability of a transceiver to determine its geographic location, identify and authorize its user, encrypt or decrypt signals, sense neighbouring wireless devices in operation, and adjust output power and modulation characteristics.

There are two main types of cognitive radio, full cognitive radio and spectrumsensing cognitive radio. Full cognitive radio takes into account all parameters that a wireless node or network can be aware of. Spectrumsensing cognitive radio is used to detect channels in the radio frequency spectrum. The Federal Communications Commission (FCC) ruled in November 2008 that unused portions of the RF spectrum (known aswhite spaces) be made available for public use.White space devicesmust include technologies to prevent interference, such as spectrum sensing and geolocation capabilities.

II. LITERATURE SURVEY

A brief overview of the cognitive radio technology is provided and the xG network architecture is introduced. Moreover, the xG network functions such as spectrum management, spectrum mobility and spectrum sharing are explained in detail. The influence of these functions on the performance of the upper layer protocols such as routing and transport are investigated and open research issues in these areas are also outlined. Finally, the cross-layer design challenges in xG networks are discussed[1]. The principal objective of CR is to optimize the use of under-utilized spectrum through robust and efficient spectrum sensing (SS). This paper introduces cognitive functionality and provides anin-depth comparative survey of various spectrum awareness techniques interms of their sensing accuracy and computational complexities along with their merits and demerits. Specifically, key challenges in SS are highlightedand possible solutions are discussed.[2]. Compounding the confusion is the use of the broad term cognitive radio as a synonym for dynamic spectrum access. As an initial attempt at unifying the terminology, the taxonomy of dynamic spectrum access is provided. In this article, an overview of challenges and recent developments in both technological and regulatory aspects of opportunistic spectrum access (OSA).[3]

To provide a better understanding of CR networks, this article presents recent developments and open research issues in spectrum management in CR networks. More specifically, the discussion is focused on the development of CR networks that require no modification of existing networks.[4] A cognitive radio body area network (CRBAN) is a CR-enabled WBAN. Unlike other wireless networks, CRBANs have specific requirements, such as being able to automatically sense their environments and to utilize unused, licensed spectra without interfering with licensed users, but existing protocols cannot fulfill them. [5] The usage of the radio spectrum for wireless communication is considered to be inefficient. Therefore, through cognitive radio, unlicensed users can occupy idle spectrum bands without interference with the primary user. Generally, when the arrival rate of licensed users is high, secondary users may starve. In this paper, we propose two models to improve the average total waiting time for the secondary user. They are the M/D/1 model of a primary user delay system with non-pre-emptive priority and pre-emptive priority.[6] We particularly show that, for the same average CR transmission link availability, the packet system time significantly increases in a semi-static network with long operating and interruption periods compared to an OSA network with fast alternating operating and interruption periods.We also present results indicating that, due to the presence of interruptions, priority queueing service disciplines provide a greater differentiated service in OSA networks than in traditional networks. [7].

III. PROPOSED WORK

We explain our system model by stating the assumptions made and by discussing the behaviour of PU and SU in the CRN.

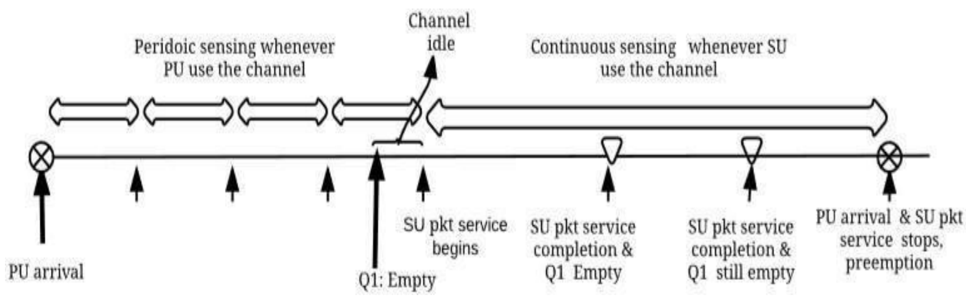

Fig: MAC protocol

Using MAC protocol the secondary users sense the channel to know whether primary user is accessing the channel or not.When ever the primary user is accessing the channel ,the secondary user senses the channel periodically with some time period.When ever the secondary user finds that the channel is idle the immediatetly SU packet service begins.During this the SU senses the channel continuously and when ever there is arrival of primary user then the secondary user will stop its service and gets pre-empted this is how the MAC protocol works. Our literature is limited to MAC protocols which are analyzed using queuing theory. A preemptive opportunistic medium access control(POMAC)[6] has been proposed which consists of three phases namely network utilization,initializing and contention. In CRN, to provide both the PU and SU with better QoS, a novel priority queuing model has been proposed and analyzed.

A new queuing model in CRN for different classes of traffic with non preemptive and preemptive service discipline has been analyzed in . Wanguo have analyzed the performance of SU using two dimensional Markov chain and queueing theory when PU follows the general distribution. A new priority queue technique called T-preemptive priority has been proposed for CRN, in which server periodically check the queuing states with period T and always given priority to higher class queues.

A new queuing scheme has been proposed in underlay mode of CRN for preemptive transmission of heterogeneous packets. In this scheme, safety messages or emergency messages are given high priority over non emergency messages. In CRN, PUs are given higher priority over SUs to occupy the channel at any time, since PUs are the licensed owners of the channel. In real time, whenever the PU has some data, it will immediately transmit the data. PU need not to sense the channel because it is the authorized user on that channel. On the other hand, whenever there is an opportunity, SUs try to access the channel for data transmission and vacate the channel if PU returns.

A. Assumptions Following are the assumptions made in our work:

- PU can preempt the transmission of SU to ensure an interference-free environment for the PUs.
- When the transmission of the SU is preempted by PU, the rest of the SU packet will be transmitted in the next server visit (next idle time of PU), i.e. preemptive resume discipline.
- SU sensing time and server switching times are negligible.

B. PU behaviour

We assume that there is only one PU, who is authorized to transmit data on the channel. We assume that the arrivals to PU follows Poisson process with parameter λp and the service times of PU are exponentially distributed with parameter μp.

ISSN- 2394-5125 Vol 4, Issue 2, 2017

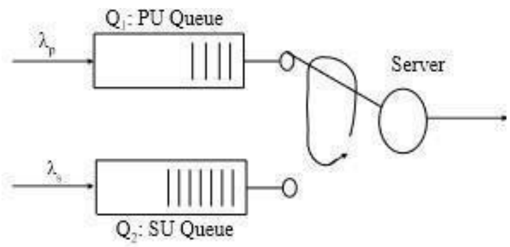

Fig: Two queue single server model

C. Mechanism

Here we have PU queue and SU queue mainly.The server first gives the priority to the PU queue and starts serving them,when ever the PU queue is empty then the server switches to SU queue and starts serving SU queue and if any one single user enter the PU queue the server switches the the PU queue and starts serving PU queue.Hence this is how two queue single server model works.

D. SU behavior

We assume that the SU arrival process is Poisson with parameter λs and the service times of SU are exponential with parameter μs. SU can senses the channel either periodically or continuously during the channel access (when PU is transmitting), whereas the SU always uses the continuously senses mode during the SU transmission.

IV. RESULTS AND DISCUSSION

We present simulation results and their discussions by first outlining the simulation methodology. We have used MATLAB to perform discrete-event based simulation. As mentioned in section II, arrival processes of PU and SU follows Poisson process with parameters λp and λs, respectively. The service times of PU and SU are exponentially distributed μp and μs. We have considered 20 sample paths and in each sample path length is 100000, i.e., we have performed 20 iterations and in each iteration we have generated 100000 packet instances.

In all the simulation experiments, the values of finite buffer sizes of PU and SU queues are taken as Q1 = 10 and Q2 = 14. In all the following graphs, cs and ps represents continuous sensing and periodic sensing, respectively.

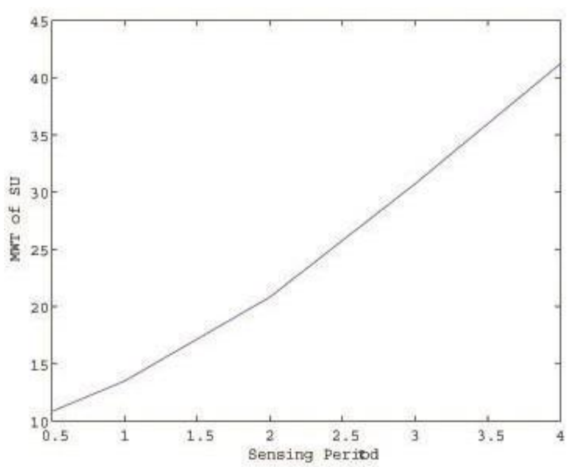

Fig:4.1.1 Sensing period vs MWT of SU: P=0.5,s=0.5,p=1,s=2

Observations:

- If the sensing period is large, the time interval over which channel is idle will be large and hence the SU might not detect this idleness of the channel, which leads to the increase in MWT of a tagged SU packet.
- when the sensing period is small, the SU senses the channel frequently and hence it finds the idleness of the channel as soon as the channel becomes idle (with minimum channel idle interval), which leads to the decrease in MWT of a tagged SU packet.

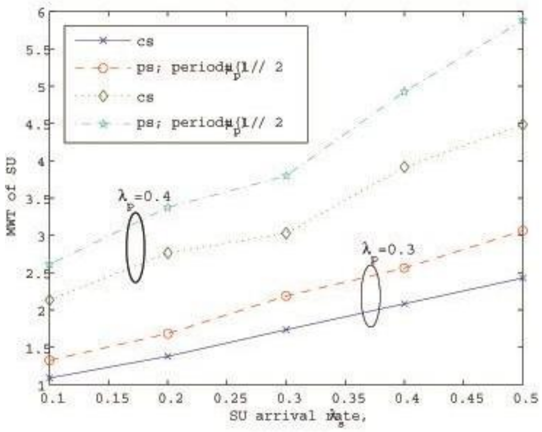

Fig: SU arrival rate λs vs. MWT of SU, for different PU arrival rates: μp = 1, μs = 2. cs: continuous sensing, ps: periodic sensing.

Observations:

- The MWT of a tagged SU packet as a function of SU arrival rate λs, for different values of PU arrival rate λp.
- As the SU arrival rate λs or PU arrival rate λp increases, the MWT of SU also increases, in both continuous and periodic sensing.

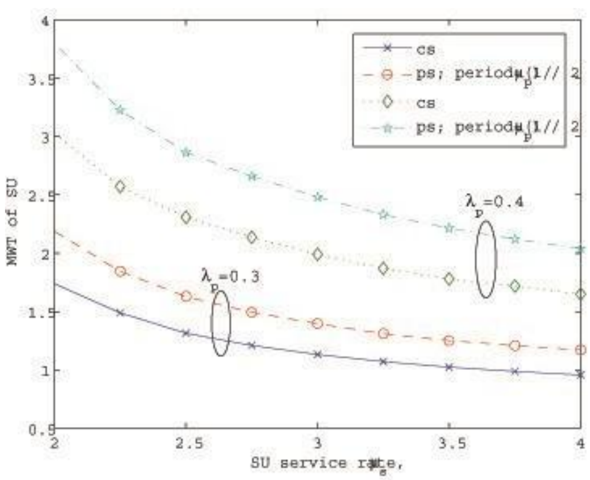

Fig:4.1.3 SU service rate μs vs. MWT of SU, for different PU arrival rates: λs = 0.3, μp = 1

Observations:

- As the SU service rates increases, the MWT of SU decreases, in both continuous and periodic sensing. This is because of the fact that as the SU service rate increases, more and more packets gets served and hence the MWT decreases.
- If the sensing period is reduced further, the MWT of SU in case of periodic sensing approaches that of the continuous sensing.

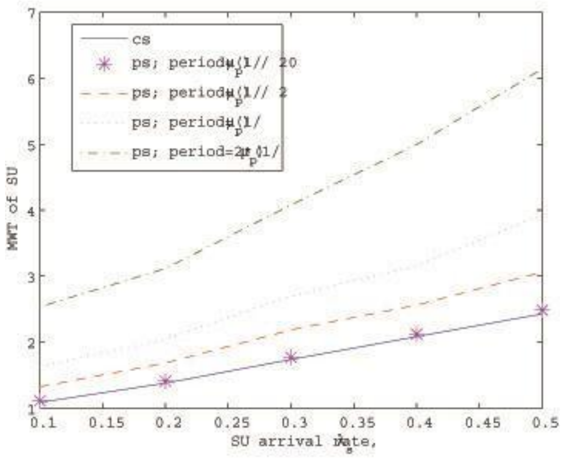

Fig: SU arrival rate λs vs. MWT of SU, for different sensing periods: λp =0.3, μp = 1, μs = 2

Observations:

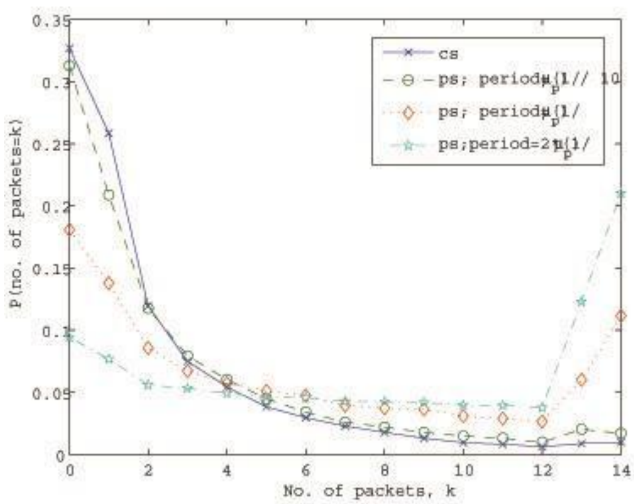

Fig:4.1.5 QLD of SU: λp = 0.5, λs = 0.5, μp = 1, μs = 4

Observations:

If the sensing period increases, the SU might not immediately notice the channel idleness and hence the SU queue builds up, i.e. the probability of queue being filled to its capacity increases, which leads to a severe packet loss. Hence it is not advisable.

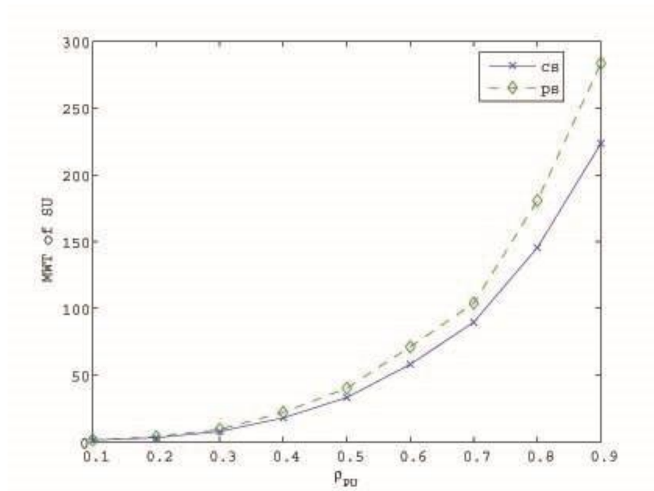

Fig:4.1.6 ρPU vs. MWT of SU: $\lambda s = 0.5$, $\mu s = 4$, $\mu p = 1$, sensing period $\tau = 1/2\mu p = 0.5$ and λp is varied

from 0.1 to 0.9

Observations:

- The MWT of SU as a function of traffic intensity of PU , for a fixed value of sensing period, i.e., amount of energy saved is constant while simulating this experiment. Hence, we can draw a conclusion that for higher values of PU , it is advisable for the SU to use continuous sensing rather than periodic sensing.
- For smaller values of PU (say PU< 0:5), SU can use periodic sensing. A small amount of increase in MWT is allowable as there can be a significant saving some of the sensing energy.

V. CONCLUSION

This work proposed a hybrid sensing mechanism for the SU during the channel access, with the aim to reduce the energy consumption of SU.We have studied its performance in a CRN environment with preemptive priority for the PU over the SU. If the SU senses the channel continuously then the energy will be wasted but it can access the channel immediately without any delay ,that means the mean waiting time will also be reduced.If the SU senses the channel periodically when the PU is using the channel for transmission, then here energy will be saved but the SU cannot access the channel immediately,there will be some delay in accessing the channel,so the efficiency will be reduced because the mean waiting time will be increasedwhen the SU senses the channel periodically.so,if we want the protocol to access the channel immediately without any delay the it must sense continuously,so that energy will be wasted. If our protocol is made to not waste energy then there will be delay in accessing the channel .

From the simulation results, we observe that as the sensing period increases, the MWT of SU also increases and the probability of queue being filled to its capacity also increases. We have also observed that as the sensing period decreases, the MWT in the case of periodic sensing approaches that of continuous sensing. From the simulation results, it is advisable for the SU to use periodic sensing with an appropriate value of sensing period for smaller values of PU server utilization (or traffic intensity). However the continuous sensing mode of channel access is recommended for larger values of PU server utilization.

REFERENCES

[1] I. F. Akyildiz, W.-Y. Lee, M. C. Vuran, and S. Mohanty, ―Next generation/dynamic spectrum access/cognitive radio wireless networks: a survey,‖ Computer networks, vol. 50, no. 13, pp. 2127–2159, 2006.

[2] S. Haykin, ―Cognitive radio: brain-empowered wireless communica-tions,‖ IEEE journal on Accord-ing to the studies conducted by FCC, WSA etc. spectrum utilization varies between 5% to 85%.

[3] Q. Zhao and B. M. Sadler, ―A survey of dynamic spectrum access,‖ IEEE signal processing magazine, vol. 24, no. 3, pp. 79–89, 2007.

[4] I. F. Akyildiz, W.-Y. Lee, M. C. Vuran, and S. Mohanty, ―A survey on spectrum management in cognitive radio networks,‖ IEEE Communica-tions magazine, vol. 46, no. 4, 2008.

[5] A. De Domenico, E. C. Strinati, and M.-G. Di Benedetto, ―A survey on mac strategies for cognitive radio networks,‖ Communications Surveys & Tutorials, IEEE, vol. 14, no. 1, pp. 21–44, 2012.

[6] V. Bassoo and N. Khedun, ―Improving the quality of service for users in cognitive radio network using priority queueing analysis,‖ IET Communications, vol. 10, no. 9, pp. 1063–1070, 2016.

[7] A. Azarfar, J.-F. Frigon, and B. Sanso,` ―Priority queueing models for cognitive radio networks with traffic differentiation,‖ EURASIP Journal on Wireless Communications and Networking, vol. 2014, no. 1, pp. 1–21, 2014.