Scientific Journal of Impact Factor (SJIF): 5.71
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406
International Journal of Advance Engineering and Research Development
Volume 6, Issue 06, June -2019

Traffic based Spectrum Allocation in Cognitive Radio Network

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Abstract: *Cognitive Radio's flexibility is the capability to alter its configuration. The holes in the spectrum called as white spaces are indications of under-utilization of the network. This paper focuses on the increasing the spectrum utilization efficiency thereby allocating the free spaces to secondary users with limited license of access. The scheme proposed in this paper is based on traffic level measurement by sensing its interference level. The performance evaluation is done for throughput and packet delivery ratio parameters. The results obtained show better improvement compared to existing cognitive radio network scenarios.*

Keywords: *Cognitive radio, spectrum allocation, Interference*

I. INTRODUCTION

Wireless communication have shown significant impact on day to day life of human being. Also, there continuously is increasing demand of wireless communication. The spectrum scarcity problem due to limited licensing of frequency bands allocated by Federal Communication Commission (FCC). With respect to time analysis [1, 2] the fraction of spectrum is underutilized. The wastage of spectrum is required to be avoided thereby allocating them with respect to demand using dynamic spectrum allocation schemes. The cognitive radio (CR) for dynamic spectrum allocation along with traffic based spectrum sensing technique is main focus of this paper.

In CR secondary users are allowed to access the spectrum when those unoccupied by primary users with resulting in increasing the efficiency of spectrum utilization [3,4]. Some researchers have shown work which includes a framework for dynamic spectrum sharing in CR for bandwidth efficient utilization [5]. In CR based network it is feasible to detect and scan the adjacent parameters of channel spectrum for reutilization scenarios to increase efficiency.

The hole in spectrum called as white space can be allocated to secondary users to access the network resources. The underlying approach for this facilitation is known as dynamic spectrum access (DSA). The opportunistic sensing is done by secondary users to decide the presence of primary users based on which the spectrum is used by keeping interferes with the activities of the primary users as little as possible.

II.RELATED WORK

Minal S. Moon et al [4] have proposed an approach for channel selection for data communication using energy detection sensing technology. A new data structure called Preferable Channel List has been introduced in the proposal. PCL has been used for selection of channel in systems where the receiver is dominant. The proposed system gives reasonable throughput while keeping the delay at a minimum.

Dibakar Das et al [5] have used Lyapunov drift techniques using which caching and scheduling is performed between the primaries and secondary. The priority of the resource is maintained using the Variable Primary Caching Policy (VPCP) algorithm. The simulation has been carried out to compare the performances of the proposed algorithm and the non-co-operative algorithm. The proposal also extends the analysis to a network with multiple channels.

Indika A. M. Balapuwaduge, Lei Jiao, VicentPla [6] have proposed a queue-based channel assembling strategy for heterogeneous channel CRNs and analytical structure for performance evaluation of such networks. They achieved significant reduction in forced terminations of ESU services. This proposal is recommended if PUs are more active in a CRN.

Autonomous spectrum allocation algorithms are proposed in [7–11], where the spectrum access is accomplished by achieving individual goals like the QoS requirements or the energy consumption of a given SU. In [7, 8], the focus is on computing the minimal SU's transmission power that satisfies the individual SUs' QoS goals. The algorithm proposed in [9] employs Stackelberg's game theory to calculate the optimal resource allocation, while the algorithm proposed in [10] selects the SU pair with the highest Signal to Noise Ratio (SNR) to utilize the lowest transmission power. [11] presents a pricing-based non-cooperative game model for power control by SUs. The objective is to provide throughput fairness among these users while guaranteeing a minimum Signal to Interference and Noise Ratio (SINR) at the secondary receiver.

In [12], the authors propose a scalable MAC protocol for heterogeneous machine-to-machine networks. The proposed protocol achieves hierarchical performance by using different contending priorities and incorporates both the persistent Carrier Sense Multiple Access (CSMA) and Time Division Multiple Access (TDMA) schemes. Moreover, an incremental contention priority scheme is used to guarantee fair access among multiple heterogeneous devices.

III. PROPOSED WORK

The block diagram of proposed work to be implemented with the methodology is as shown in in figure 1.

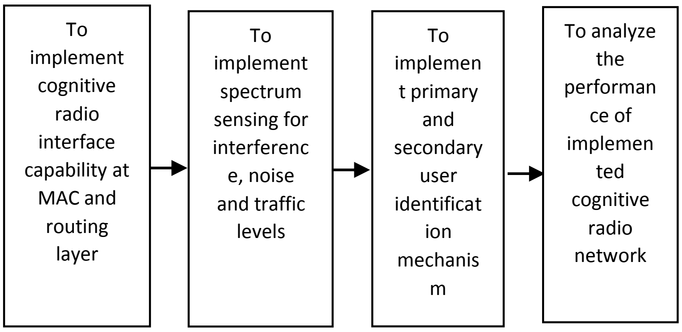

Figure 1: Conceptual block diagram of proposed work

Threshold interference level at primary user receiver

PU always maintains its threshold SNR irrespective of numbers of SUs enter into the network. The total interference caused by SUs at PU receiver should always be less than to a predefined level I_{max}. The Quos requirement for the PU receiver can be expressed as:

$$\sum_{i=0}^{N} g_{pu,i} P_i \leq I_{max}$$

…….(1)

5.2 Target SNR of SUs

SUs received SNR constitutes the SU Quos. SNR of the it SU receiver is given as follows:

$$\gamma_i = \frac{g_{i,i}(t)\, P_i\,(t)}{\sum_{j=1,j\neq i}^{N} g_{i,j}(t)\, P_j(t) + N_o B}$$

…....(2)

where No is the power spectral density of the AWGN noise and B represent the received signal bandwidth. Assuming that all SUs are working on same threshold SNR (Myth), reliable communication would occur only when

$$\gamma_i \geq \gamma_{th}$$

…….(3)

Considering the Quos requirement as given in Eq. (3) for SUs, Eq.(2) can be expressed as

$$P_i \geq \gamma_{th} \left(\sum_{j=1,j\neq i}^{N} \frac{g_{i,j} P_j}{g_{i,i}} + \frac{N_o B}{g_{i,i}} \right)$$

…….(4)

Let vector P=(PI, PI, Pl .... PN) T denotes the transmit power of the users, Eq. (4) can be rewritten with equality in the matrix form as follows

$$(\boldsymbol{I} - \boldsymbol{F})\boldsymbol{P} = \boldsymbol{U}$$

…….(5)

Where I is N x N identity matrix and F is an N x N & U is an N x 1 matrix, are specified as

$$\boldsymbol{F(i,j)} = \begin{cases} \gamma_{th} \dfrac{g_{i,j}}{g_{i,i}}, & i \neq j \\ 0, & i = j \end{cases}$$

$$\boldsymbol{U} = \gamma_{th} \frac{N_o B}{G_{i,i}}$$

…….(6)

If the maximum eigenvalues of matrix F is less than 1, there exists a non-negative P, which satisfies the Eq. (5). The required threshold SNR is achievable with P* = (I - F)-1U being the Pareto optimal solution and the system is feasible[8]. However, SUs cannot increase their transmit power indefinitely; there must be an upper limit for SUs transmitted power as

$$0 \leq P_i \leq P_{\mathbf{peak}} \qquad \textit{for all SUs}$$

SU can make communication when their transmit power requirement satisfy.

IV. RESULTS AND ANALYSIS

The performance evaluation is done for the system implemented in NS3 using various parameters such as throughput and packet delivery ratio. The performance is compared to non-cognitive radio system as an existing system approach. The configuration of parameters is as shown in table I. The results are analyzed for various combinations of packet sizes 256 and 512 bytes with change in transmission change thereby changing the interference while sensing the spectrum.

Table I: configuration of parameters

CBR Packet Size	256,512
Transmission Range	5, 20, 30, 50, 100
Number of Nodes	50
Number of hops	3
Simulation Time	150.0 Seconds

Throughput Analysis

Throughput for different scenarios are calculated and observations are tabulated. Throughput can be calculated as,

$$T = P_r / t$$

Where, T is Throughput, P_r is total packets received and t is time taken to reach all the packets to receiver.

Table II: Throughput analysis for packet size 256 bytes

Transmission Range	PROPOSED	EXISTING
5	189.6	151.6
20	241.51	170.44
30	320.45	240.22
50	336.96	270.18
100	391.78	310.23

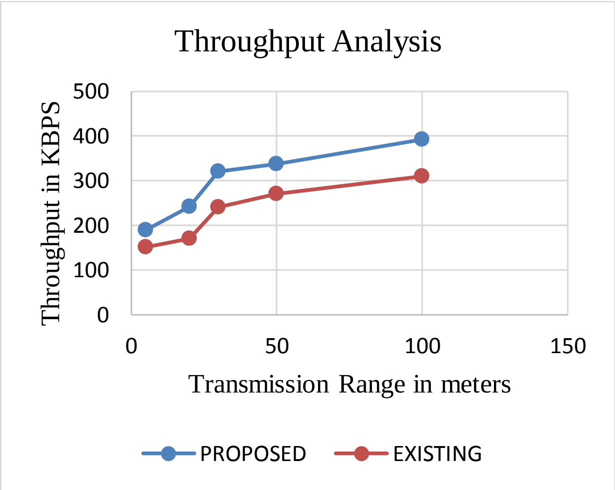

Figure 2: Throughput analysis graph for packet size 256bytes

Table II: Throughput analysis for packet size 512 bytes

Transmission Range	PROPOSED	EXISTING
5	105.63	111.23
20	160.36	150.26
30	280.23	210.36
50	310.45	234.1
100	355.23	280.78

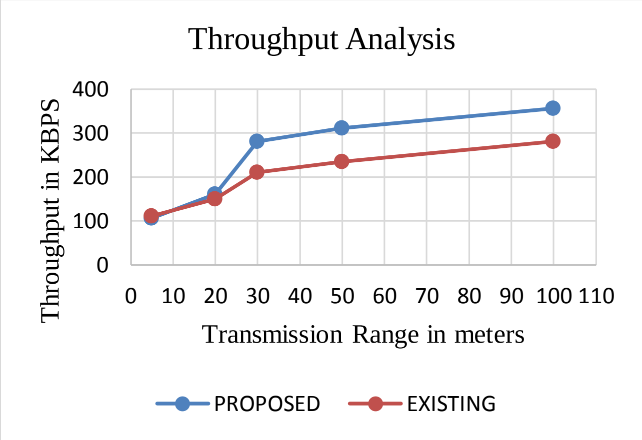

Figure 3: Throughput analysis graph for packet size 512 bytes

Packet Delivery Ration (PDR) Analysis:
Packet delivery ratio is calculated as,

$$PDR=P_r/P_s$$

Where, PDR is packet delivery ratio, P_r is total number of packets received successfully and P_s is total number of packets sent successfully.

Table IV: PDR analysis for packet size 256 bytes

Transmission Range	PROPOSED	EXISTING
5	0.79	0.65
20	0.84	0.67
30	0.86	0.7
50	0.89	0.83
100	0.914	0.89

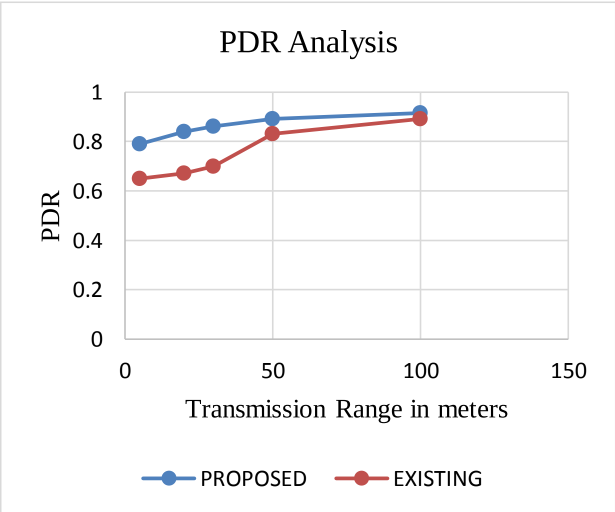

Figure 4: PDR analysis graph for packet size 256 bytes

Table V: PDR analysis for packet size 512 bytes

Transmission Range	PROPOSED	EXISTING
5	0.81	0.62
20	0.82	0.657
30	0.85	0.694
50	0.88	0.816
100	0.9	0.884

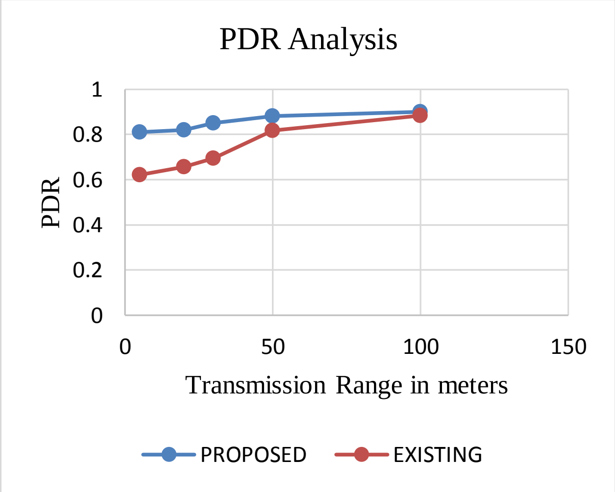

Figure 5: PDR analysis graph for packet size 512 bytes

Figure 2 and 3 show the throughput analysis graph for values in table II and III for packet size 256 bytes and 512 bytes respectively.
Figure 4 and 5 show the throughput analysis graph for values in table IV and V for packet size 256 bytes and 512 bytes respectively.

Annotations:

1. The proposed system of cognitive radio network shows better performance in terms of throughput and PDR
2. The efficient spectrum allocation provides the respective response in terms of faster packet delivery thereby increasing throughput along with packet delivery ratio.

V. CONCLUSION

Based on our simulated experimentation we conclude that increment in contention free time slot increases the network performance in terms of throughput and packet delivery ratio. We also conclude from observations that, as traffic due to increment in number of nodes in the network increases the network performance decreases but it can be made adequate when time slot for contention free period is increased.
Spectrum sharing and power allocation are interesting issues in cognitive radio networks. In our paper, we analyze the spectrum sharing scenario with a pricing scheme in a cognitive radio network. We demonstrate the joint optimal allocation scheme of both spectrum and power for secondary users buying spectrum from multiple primary users. The joint optimal allocation scheme maximizes secondary users' utilities while primary users' utilities meet certain requirements. Moreover, we illustrate a distributed resource allocation scheme to join optimize usage of power and spectrum. In this project we have reviewed different spectrum sharing technique available in literature. Cognitive radio is one of the methods to utilized the spectrum efficiently and key element of cognitive radio is spectrum sharing. These techniques when implemented in real world, will prove as a boon to everyone. The spectrum will be efficiently used and available for a person in need. Spectrum sharing is used for share the spectrums. If any channel (licensed channel) is free then another channel (unlicensed channel) can access the free channels.

REFERENCES

[1] S.Tamilarasasan, Dr.P.Kumar, "A Servey on Dynamic Resource Allocation in Cognitive Radio Networks", International Journals of Computer Science and Engineering (IJCSE), volume: 4, Issue: 7, E-ISSN: 2347-2693, Jul-2016, PP: 86-93.

[2] S.Tamilarasan, Dr.P.Kumar, "Dynamic Resource Allocation in Cognitive Radio Networks-Priority Secheduling approach: Literature Survey", International Journals of Computer Science and Engineering (IJCSE), volume: 4, Issue:8, E-ISSN: 2347-2693, Aug-2016, PP:01-11.

[3] Santhamurthy Tamilarasan, Kumar Parasuraman", Dynamic Resource Allocation and Priority Based Scheduling for Heterogeneous Services in Cognitive Radio Networks", International Journal of Intelligent Engineering & Systems (IJIES), Vol.9, No.3, 2016, PP: 127-136.

[4] Indika A. M. Balapuwaduge, Lei Jiao, Vicent Pla, "Channel Assembling with Priority-Based Queues in Cognitive Radio Networks: Strategies and Performance Evaluation", IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, VOL. 13, NO. 2, FEBRUARY 2014, PP: 630-645.

[5] Minal S. Moon, Veena A. Gulhane. "Preferable channel list based channel selection in cognitive radio network", IRACST – International Journal of Computer Networks and Wireless Communications (IJCNWC), ISSN: 2250-3501, Vol.6, No 2, Mar-Apr 2016, PP: 115-119.

[6] Dibakar Das, Alhussein A. Abouzeid, “Co-Operative Caching in Dynamic Shared Spectrum Networks”, IEEE Transactions On Wireless Communications, VOL. 15, NO. 7, July 2016, PP: 5060-5075.
[7] Y. Huang, Q. Li, W.-K. Ma, and S. Zhang, “Robust multicast beamforming for spectrum sharing-based cognitive radios,” IEEE Transactions on Signal Processing , vol. 60, no. 1, pp. 527–533, 2012.
[8] J. Tadrous, A. Sultan, and M. Nafie, “Admission and power control for spectrum sharing cognitive radio networks,” IEEE Transactions on Wireless Communications , vol. 10, no. 6, pp. 1945–1955, 2011.
[9] R. Xie, F. R. Yu, and H. Ji, “Energy-efficient spectrum sharing and power allocation in cognitive radio femtocell networks,” in IEEE International Conference on Computer and Communication (INFOCOM), 2012, pp. 1665–1673.
[10] T. W. Ban, W. Choi, and D. K. Sung, “Capacity and energy efficiency of multi user spectrum sharing systems with opportunistic scheduling,” IEEE Transactions on Wireless Communications, vol. 8, no. 6, pp. 2836–2841, 2009.
[11] X. Xie, H. Yang, A. V. Vasilakos, and L. He, “Fair power control using game theory with pricing scheme in cognitive radio networks,” Journal of Communications and Networks, vol. 16, no. 2, pp. 183–192, 2014.
[12] Y. Liu, C. Yuen, X. Cao, N. U. Hassan, and J. Chen, “Design of a scalable hybrid MAC protocol for heterogeneous M2M networks,” IEEE Internet of Things Journal, vol. 1, no. 1, pp. 99–111, 2014.

