ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 4, April 2015

Optimum Channel Sharing in Cognitive Radio Network

S.Bharathy[1], T.Perarasi[2], Dr.G.Nagarajan[3]

Dept. of M.E. VLSI Design, KVCET, G.S.T Road, Chinnakolambakkam, Kanchipuram, India

Associate Professor, Department of ECE, KVCET, G.S.T Road, Kanchipuram, India

Professor and Head, Department of ECE, Pondicherry Engineering College, Pondicherry, India

ABSTRACT: Cognitive Radios emerged as a means of improving the efficiency of current spectrum allocation policy by utilizing the available unused spectrum. There are many challenges in the systematization of Cognitive Radio Network, and the most obvious is to fulfil the awareness requirement. The nodes must be able to share the spectral information which requires inter node communication, hence that shared channel is needed that can be operated under various mode activities from the primary users. MAC layer (IEEE 802.22) protocol is suitable for channel sharing and proved that the resulting controlled channel sharing performs better than the traditional sensing based MAC algorithms, the proposed algorithm for solving this problem has provably tight bounds in terms of the max-min throughput. In order to make less number of reconfigurations in the network, localized version share algorithm is preferred in CR network. Thus helps to combine the centralized algorithm and its localized version and hence the complete protocol is able to achieve high fairness and high network throughput with few channel reconfigurations.

KEYWORDS: Throughput, channel sharing protocol, Cognitive Radio, WRAN APs.

I. INTRODUCTION

Cognitive radio is considered as a goal towards which a Software Defined Radio (SDR) platform should be evolved as a fully reconfigurable wireless transceiver which automatically adapts its communication parameters to network and user demands. Traditional regulatory structures have been built for an analogy model and are not optimized for cognitive radio. Regulatory bodies in the world (including the Federal Communications Commission in the United States and the United Kingdom) as well as different independent measurement campaigns found that most radio frequency spectrum was inefficiently utilized.

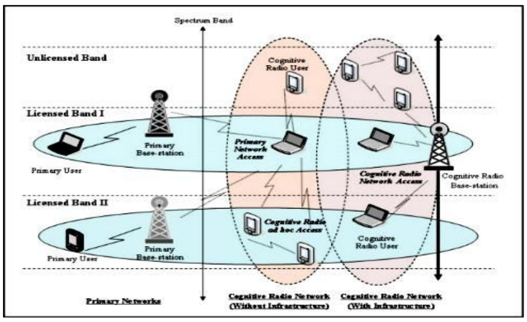

Fig.1. A cognitive radio network

The Cellular network bands are overloaded in most parts of the world but other frequency bands (such as military, amateur radio and paging frequencies) are insufficiently utilized. The independent studies performed in some countries confirmed that spectrum utilization depends on time and place, as well fixed spectrum allocationPrevents

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 4, April 2015

rarely used frequencies (those assigned to specific services) from being utilized, even when any unlicensed users would not cause noticeable interference to the assigned service. Administrative bodies in the world have been considering whether to allow unlicensed users in licensed bands if they would not cause any interference to licensed users. These initiatives have been focused in Cognitive Radio research on optimum channel sharing.

A. Why for Cognitive Radio

The Cognitive Radio is an intelligent radio that can be programmed and configured dynamically. The CR is a transceiver which is designed to utilize the best wireless channel in its vicinity. Such a radio automatically detects applicable channels in wireless spectrum, then consequently changes its transmission or reception parameters to allow more concurrent wireless communication in a given spectrum band at one region. The Cognitive Radio network as shown in Fig.1. Cognitive Radio (CR) technology has gained attention due to the FCC mandate that does allows unlicensed radios to operate in the unused portions of the UHF band. Such channels, however, need to be relinquished when primary (or incumbent) users begin using them. Solutions that can opportunistically use such channels can help alleviate the congestion in the ISM bands. Advances inhardware technologies have made it possible to simultaneously use the capacity of a large number of channels that may share or may not be contiguous by the use of non-contiguous OFDMA.

Even if a collision happens on one of the channels utilized by the node, the packets transmitted on other channels are still delivered successfully. But, parallel with multiple channels attribute to access points, it has been that if neighboring APs are assigned different channels. White space will give bandwidth of less than 720 Kbps per user. This particularly limits the applications that have high bandwidth requirements of the order of 5-6 Mbps such as HD video Streams and HD video convocations. One way to further increase the available bandwidth is by allowing neighboring APs to opportunistically share channels. This increases the number of collisions, but at the same time it can increase throughput of APs under several scenarios. Cognitive Radio is defined as a radio or system that senses its operational electromagnetic environment and can dynamically and autonomously adjust its radio operating parameters to customize system functions like maximized throughput, moderate interference and facilitate interoperability.

B. Overview of the System

A cognitive radio scans the radio environment for spectrum holes (vacant frequency bands). After recognize the spectrum holes, it choose the best possible spectrum hole based on the requirements for transmission and most importantly vacates the channel when the licensed user returns. The main functions of cognitive radio are sensing management, mobility and sharing. These operation design the building blocks of the cognitive radio cycle and are shown in a model form in Fig.2. There are several interesting research areas which focus on the individual functionalities of cognitive radio.

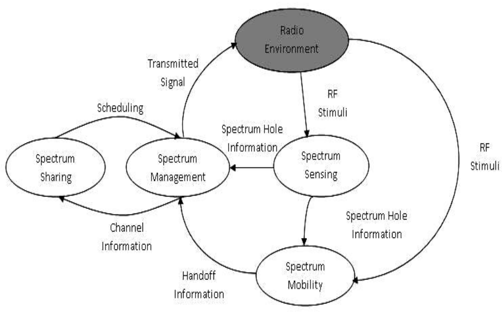

Fig.2 Cognitive Radio Cycle

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 4, April 2015

C. Spectrum Sensing

It is the first and most important function of a cognitive radio. It is the process for detecting unused portions of spectrum in order to use them opportunistically. One of the main challenges of CR is gaining spectrum awareness that will be able to undertake reliable and sufficiently sensitive spectrum sensing. It enables theCognitive radio to be aware and sensitive to the changes in its environment by detecting the white spaces in primary user's spectrum. The spectrum sensing technique can be broadly classified into three groups they are Interference temperature management, Primary receiver and transmitter detection.

1) Spectrum Management

Once the spectrum holes are detected, the Cognitive Radio must be able to choose the channel that suits its communication requirements. In order to address the challenges, each CR user in the CR network must determine which portions of the spectrum are available, select the finest possible channel, coordinate access to this channel with other users and vacate the channel when a licensed user is detected.

2) Spectrum Mobility

Since the Cognitive Radios provide lower priority, they should be able to suspend their communication, in case a licensed user comes back and seamlessly move onto another vacant channel. The Cognitive Radio user is respect as visitor to the primary user spectrum and a reliable communication cannot be sustained for a long time if primary user uses the licensed spectrum frequently, hence the Cognitive Radio system should support mobility to continue the communication in other vacant bands.

II.SYSTEM MODEL AND CHANNEL ASSIGNMENT

A. Channel Allocation Schemes

In radio resource management for wireless and mobile network a channel allocation pattern is required tobandwidth. There are two types of strategies that are to be followed namely FCA (fixed channel allocation) that manually assigned by the network operator and DCA (dynamic channel allocation) and dynamic frequency selection Spread spectrum.

B. Shared Channel Assignment Protocol

The channel assignment protocol that allows opportunistic sharing of channels. At first the MAC layer algorithm chosen for WRANs that is suitable when neighboring SBSs share channels [14]. This estimation technique is later used by the channel assignment algorithm. The setup of our algorithm and the problem formulation, specifically the objective is to assign channels to SBSs such that the lexicographic sequence of the throughput of the SUs is maximized. Describes the Share algorithm in detail. Our algorithm works by converting the channel assignment Problem to a vertex colouring problem where vertices represent the SBSs in the channel assignment problem. However, unlike traditional graph colouring, here it is possible to assign the same channel to the neighboring vertices if the overlap between the corresponding SBSs is small.

1) Setup of the Channel Sharing Protocol

All SBSs send their sensing data (via Channels available, number of associated clients and the set of neighboring SBSs of each client on each channel) to the Channel Assignment Server (CAS).Based on this information, CAS uses the Share algorithm to jointly compute the channel assignment for each SBS as well as the channel usage probability for each channel assigned to each SBS. SBSs can deduce channels available to them by periodic sensing of the spectrum.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 4, April 2015

C. FCA (Fixed Channel Allocation)

In Fixed Channel Allocation or Fixed Channel Assignment (FCA) each cellular network is given a predetermined set of frequency channels [9]. FCA needs manual frequency planning, which is an exhausting goal in TDMA and FDMA based systems, since the systems are greatly sensitive to co-channel interference from nearby cells that are reusing the same channel. Another drawback with TDMA and FDMA systems with FCA is that the number of channels in the cell remains constant irrespective of the number of customers in that cell. This outputs in traffic congestion and some calls being lost when traffic gets heavy in some cells, and idle limits of volume held in other cells [13].

III.ANALYSIS AND SIMULATION

A. Performance Analysis

Though this algorithm maximizes all the terms of the non-decreasing lexicographic sequence of assigned throughput, the following analysis is restricted to only the first term of the sequence (otherwise known as the max-minterm). For that purpose, comparison of the performance of Share with the exponential time optimal algorithm of OPT is made. Assume that all SBSs have the same number of SUs (say jQj) associated with them. Here the OPT isdefined as the algorithm that maximizes the lexicographicSequence. Let $_{Share}$ ¼ min$_{1_i_M}$ T ðA$_{Share}$; r$_i$Þ; and $_{OPT}$ ¼ min$_{1_i_M}$ T ðA$_{OPT}$;r$_i$Þ.Under the assumption that jQj is 1, it can be shown that Share provides tight approximate bounds on the first term of the lexicographic non-decreasing sequence of assigned throughputs.

B. Simulation

NS-2 Tool is used for simulations. The simulation is shown in NAM format. The simulation output explained the Packet Delivery Ratio, Delay, and Energy for Transferring node etc.

1) Simulation Setup

The network of size 500m _ 5km in ns-2 is simulated. Each SBS had 50-150 clients associated with it. One of the uses of white space channels is expected to provide higher capacity to the mobile users. Thus the simulations in the mobility of SUs and the resulting variation in signal strength values (from the associated SBS as well as the neighboring interfering SBSs) was simulated using data trace from which contains the log of signal strength of different GSM towers as recorded by mobile users.

IV.SIMULATION RESULTS

A. Simulations Tool

NS2 uses two languages because simulator has two different kinds of things. On one hand detailed simulations of protocols require a systems programming language which can efficiently implement algorithms, packet headers and manipulate bytes that run over huge data sets. For these goal run-time processing speed is important and turn-around time (run simulation, find bug, fix bug, recompile, and rerun) is less important [15]. On the other hand, a huge part of network research involves slightly varying parameters or configurations or quickly exploring a number of scenarios. In these cases, iteration time (change the model and re-run) is more important. Since configuration runs once (at the beginning of the simulation), run -time of this part of the goal is less important. Ns2 meets both of these needs with two languages C++ and OTcl. C++ is fast to run but slower to change, making it applicable for detailed protocol implementation. OTcl runs much slower but can be exchanged very quickly, making it ideal for simulation configuration.ns (via tclcl) gives glue to make objects and variables appear on both languages.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 4, April 2015

B. Procedure for Simulation and Output

1. Type the program in note pad and save it in the name as “name.tcl”.

2. Save it in a location and then open the model through terminal in liunx OS.
3. Type “ nsname.tcl” in terminal and it is simulated.
4. The Packet Loss and Throughput was obtained.
5. Compile the C-Program in Window

Frame Segmentation was working.

Table.1 Simulated results for obtained Scenario

Total number of nodes	82
source station(satellite)	01
Base station	01
Access points nodes	03
Protocol	AODV
Agent	TCP, Sink
Application	FTP
Simulation time	15min(speed10ms)
Transferring power	0.5017 b/s
Sensing power	0.0175 b/s
Packet size	500 bytes
Time interval	003 ms

The Source station send the signal to Base station. The Base station send the signals to APs, that APs sense its Neighbour nodes and send data to it. In this case Fig.3 the APs node 27 (Cluster Head) send data to its node 57 at the simulation time of 9.50minutes, the node 57 received the data and transfer data to node 60 at 10.10 minutes in the speed of 10 ms.

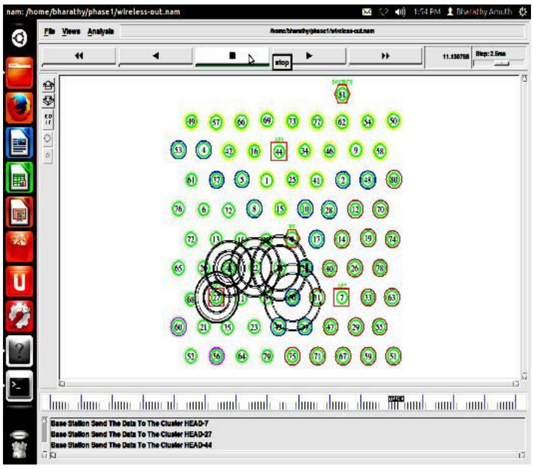

Fig. 3 Scenario for Cluster Head to node transmission The Source station send the signal to Base station

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 4, April 2015

The Base station send the signals to APs, that APs sense its Neighbour nodes and send data to it. In this case Fig.4 the APs node 27 (Cluster Head) send data to its interference node 30, the interference node 30 received the data and transfer data to another AP node 47.

In this case Fig.5 the APs node 27 (Cluster Head) send data to its node 6 at the simulation time, the node 6 received the data and transfer data to another APs(44) where it reach node 1 and the another APs44's node 1 received the data and transfer data to the APs7's node 40.

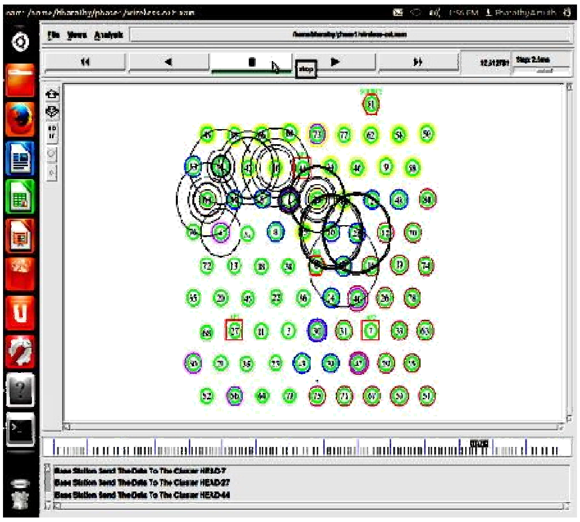

Fig.4 Scenario for Cluster Head to another Cluster Head's node transmission without using interference node

In this case Fig.6 the APs node 44 (Cluster Head) send data to its node 73, the node 73 received the data and transfer data to node 62 in the speed of 10 ms simulated. But the hacker node 77 is hacking the data of node 73. APs is find the hacker and sender side sniffer start to deleting the hackers and data transfer to node 62.

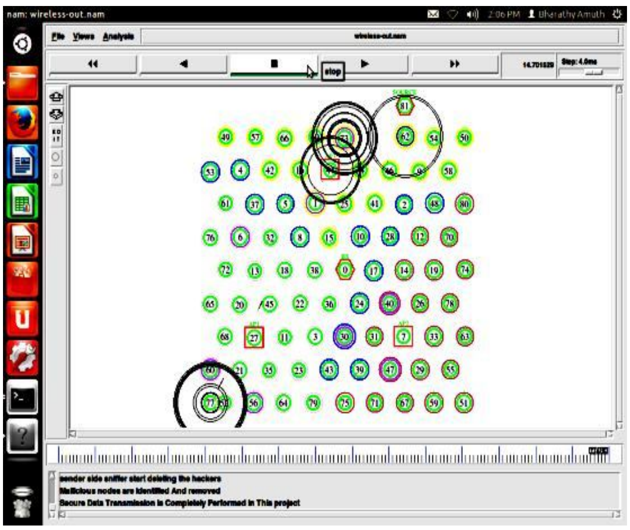

Fig. 5 Scenario for Cluster Head to secure node transmission

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 4, April 2015

C. Xgraph for Energy Diagram of Transferring node

Wireless sensor node is interact with the energy consumption of the sensor nodes, applications and routing protocols are able to make informed decisions that increase the lifetime of the sensor network.

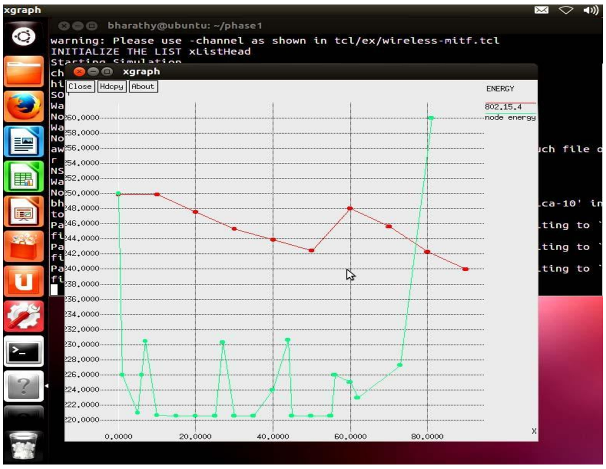

Fig. 6 Scenario for Energy diagram for Transferring node

Energy management is important to the reliability of the network. The description of the application may make it infeasible for interaction with the sensor once it has been deployed. Frequently the sensors are located in remote areas making it impossible to access them. The data transferring rate is depend on node energy.

D. Xgraph for Packet Delivery Ratio

Throughput is the rate of successful message delivery over Communication channel a part of the data message is delivered over a physical or logical link, or it can able pass through a certain network node. Throughput is comely measured in bits per second and consistently in data packets per second or data packets per time slot. The system throughput or cumulative throughput is the sum of the data rates that are delivered to all terminals in a network.

Throughput is essentially synonymous to digital bandwidth consumption, it can be analysed mathematically by applying the queuing theory, the load in packets per time is denoted as the arrival rate (λ), and the throughput, in packets per time unit, is denoted as the departure rate (μ).The throughput of a communication system may be affected by different factors, including the limitations of underlying analog physical medium, usable processing power of the system components, and end user behavior. When different protocol overheads are taken into account, available rate of the transferred data can be significantly lower than the maximum achievable throughput.

V. CONCLUSION

The proposed new paradigm for channel sharing in which neighboring APs can be assigned the same channel. The sharing can lead to an increase in both fairness and total system throughput. It is shown that the problem of fair channel assignment to WRAN APs under this shared channel paradigm is NP Hard, that modified the IEEE 802.22 MAC layer protocol to make it suitable for channel sharing and proved that the resulting controlled channel sharing performs better than the traditional sensing based MAC algorithms, then proposed algorithm Share for channel assignment. The proposed algorithm for solving this problem has provably tight bounds in terms of the max -min throughput. In order to reduce the number of reconfigurations in the network, the proposed is localized version. Combining the centralized algorithm and its localized version, the complete protocol is able to achieve high fairness and high network throughput

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 4, April 2015

with few channel reconfigurations.Our algorithm for channel assignment can be extended to be used for Wi-Fi APs as well. However, there we also need to take into account the possibility of using overlapping channels for additional throughput gains. It would be interesting to explore how channel sharing performs for both downstream and upstream transmissions and hardware implementation.

REFERENCES

[1] L. Cowen, W. Goddard, and C. Jesurum, "Defective Coloring Revisited," *J. Graph Theory*, vol. 24, pp. 205-219, 1995.
[2] Y. Cao and V.O.K. Li, "Scheduling Algorithms in Broad-Band Wireless Networks," *Proc. IEEE*, vol. 89, no. 1, pp. 76-87, Jan. 2001.
[3] M. Iridon, D.W. Matula, and C. Yang, "A Graph Theoretic Approach for Channel Assignment in Cellular Networks," *Wire-less Networks*, vol. 7, no. 6, pp. 567-574, 2001.
[4] L. Narayanan and S.M. Shende, "Static Frequency Assignment in Cellular Networks," *Algorithmica*, vol. 29, no. 3, pp. 396-409, 2001.
[5] J. Elson, L. Girod, and D. Estrin, "Fine-Grained Network Time Synchronization Using Reference Broadcasts," *ACM SIGOPSOperating Systems Rev*., vol. 36, no. SI, pp. 147-163, 2002.
[6] Elson, L. Girod, and D. Estrin, "Fine-Grained Network Time Synchronization Using Reference Broadcasts," *ACM SIGOPSOperating Systems Rev.*, vol. 36, no. SI, pp. 147-163, 2002.
[7] Mishra, S. Banerjee, and W. Arbaugh, "Weighted Coloring Based Channel Assignment for WLANs," *ACM SIGMOBILEMobile Computing and Comm. Rev.*, vol. 9, no. 3, pp. 19-31, 2005.[8] Akyildiz, W. Lee, M. Vuran, and S. Mohanty, "NeXt Generation/Dynamic Spectrum Access/Cognitive Radio Wireless Net-works: A Survey," *Computer Networks*, vol. 50, no. 13, pp. 2127-2159, 2006.
[9] M. Alicherry, R. Bhatia, and E.L. Li, "Joint Channel AssignmentRouting for Throughput Optimization in Multiradio
Wireless Mesh Networks," *IEEE J. Selected Areas in Comm*., vol.
24, no. 11, 1960-1971, Nov. 2006.
[10] J. Jia, Q. Zhang, and X. Shen, "HC-MAC: A Hardware-Constrained Cognitive MAC for Efficient Spectrum Management," *IEEE J. Selected Areas in Comm*., vol. 26, no. 1, pp. 106-117, Jan.2008.
[11] A.T. Hoang and Y.-C. Liang, "Downlink Channel Assignment and Power Control for Cognitive Radio Networks," *IEEE Trans.Wire-less Comm*., vol. 7, no. 8, pp. 3106-3117, Aug. 2008.
[12] Stevenson, G. Chouinard, Z. Lei, W. Hu, S. Shellhammer, and Caldwell, "IEEE 802.22: The First Cognitive Radio Wireless Regional Area Network Standard," *IEEE Comm. Magazine*, vol. 47, no. 1, pp. 130-138, Jan. 2009.
[13] E.Villegas, R. Ferr_e, and J. Paradells, "Frequency Assignments in IEEE 802.11 WLANs with Efficient Spectrum Sharing," *Wireless Comm. and Mobile Computing*, vol. 9, no. 8, pp. 1125-1140, 2009.
[14] C.Cormio and K.Chowdhury,"A Survey on MAC Protocols for Cognitive Radio Networks," *Ad Hoc Networks*, vol.7, no.7, pp1315 -1329, 2009.
[15] Tarun Bansal, Dong Li, and Prasun Sinha," Opportunistic Channel Sharing in Cognitive Radio Networks" *IEEE transactionson mobile computing*, vol. 13, no. 4, April 2014.