iJRASET
International Journal For Research in
Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 6 **Issue:** IV **Month of publication:** April 2018

**DOI:** http://doi.org/10.22214/ijraset.2018.4653

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887*
*Volume 6 Issue IV, April 2018- Available at www.ijraset.com*

# Analysis of Aloha Protocols in Cognitive Radio Network

S. Siva Sankari[1], C. Jayasri[2]
[1, 2]*Department of Electronics and Communication Engineering, A.V.C. College of Engineering, Mayiladuthurai, Tamil Nadu, India.*

***Abstract: To accommodate the ever-increasing wireless service demand, cognitive radio (CR) technology is introduced. In cognitive radio networks, cooperative spectrum sensing is utilized to improve sensing performance to avoid potential interference to primary users (PUs) and increase spectrum access opportunities for secondary users (SUs). A cooperative spectrum sensing process is divided into three phases, individual sensing, reporting/fusion, and data transmission. In the reporting phase, one or more reporting channels are needed to transmit individual sensing results to a fusion center (FC), and global spectrum sensing results are determined at FC. The number of required reporting channels depends on the number of spectrum sensors or SUs, which relates to reporting channel efficiency and channel scheduling complexity. The reporting channel design can be a challenge, especially when fixed assignment scheduling is used. Therefore, in this system, we design a reporting channel scheme based on Slotted Aloha (S-Aloha) and Reservation Aloha (R-Aloha). The simulation results illustrate the effectiveness of the proposed reporting channel scheduling methods in improving cooperative spectrum sensing and analyses their throughput performance.***
***Keywords: R-ALOHA, S-ALOHA, Cognitive Radio(CR), primary Users(PU), Fusion Centre(FC)***

## I. INTRODUCTION

Cognitive Radio (CR) enables the efficient use of limited spectrum by allowing secondary users (SUs) to access the licensed frequency bands of primary users (PUs). Fig 1 Spectrum sensing is a key element required to allow SUs to use vacant frequency bands in a CR network. Many signal detection techniques such as energy detection, matched filtering, and cyclo-stationary feature detection can be used to enhance detection performance in spectrum sensing . However, in practice, many factors, such as multipath fading, shadowing, and the hidden PU problem, may significantly affect detection performance. In cooperative spectrum sensing, each sensing node reports its sensing result to a fusion center (FC). The FC determines the presence of the PU by combining multiple independent sensing results from sensing nodes. Each sensing node performs local spectrum sensing and decides the presence of a PU by using a different detection threshold. Each sensing node reports its local decision to the FC and then the FC finally decides the presence of a PU by using hard combination (HC) methods (e.g., OR-rule or AND-rule). However, the SC method shows better sensing performance than HC methods at the cost of increased bandwidth of reporting channels. In the CR networks with cooperative spectrum sensing, an FC combines multiple sensing information reported from sensing nodes. Under this setting, we are interested in determining a set of channels allocated for each secondary user in advance so that maximum network throughput can be achieved in a distributed manner. To the best of our knowledge, this important problem has not been considered before.

## II. RELATED WORK

Raed Alhamad, Huaxia Wang,Yu-Dong Yao. Has introduced the Cooperative Spectrum Sensing with Random Access Reporting Channels in Cognitive Radio Networks. The limitation of the system is reporting channel is designed using S-Aloha it reduces the channel assignment complexity.

Sedat Atmaca, Omer Sayli, Jin Yuan and Adnan Kavak has introduced the Throughput Maximization of CSMA in Cognitive Radio Networks with Cooperative Spectrum Sensing. The limitation of the system is It obtains optimum K value in K-out-N fusion rule achieves higher throughput than other fusion rule such as AND, OR and MAJORITY rule.

Lundn, M. Motani, and H. V. Poor. Has introduced the Distributed Algorithms for Sharing Spectrum Sensing Information in Cognitive Radio Networks. The limitation of the system is by using any dedicated reporting channels spectrum efficiency will be affected.

Won-yeol Lee Ian. F. Akyildiz has introduced the Optimal spectrum sensing framework for cognitive radio networks. The limitation of the system is Uses fixed assignment scheduling increases bandwidth consumption.

 

## III. PROPOSED CONCEPT

In proposed concept, we design the cognitive radio network using S-Aloha and R-Aloha.

### *A. System Model*

As shown in Fig. 1, there are two essential phases in our cognitive radio sensing and reporting framework, detection phase and reporting phase. During the detection phase, M SUs attempt to perform individual spectrum sensing to detect the presence of a PU. In the reporting phase, SUs send their individual detection results to the FC through dedicated reporting channels. By using some specific fusion rules, FC makes a final decision in determining the presence or absence of a PU. In figure 2 shows the frame structure of secondary users work, in sensing period the SU'S senses the presence of PU'S and in the reporting period the SU'S send their local Decision to the Fusion Centre (FC) by using Slotted

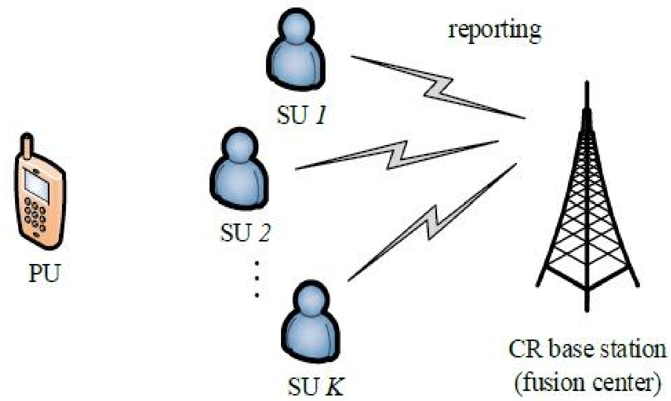


Fig.1. Cognitive Radio Sensing and Reporting

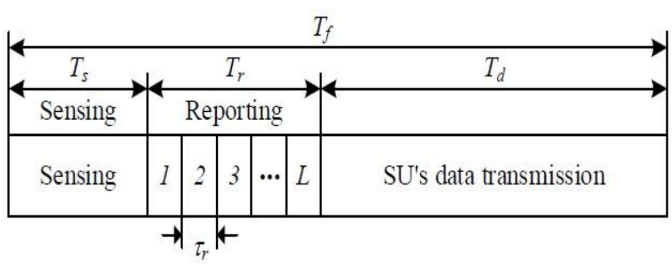


Fig.2. Frame Structure

Aloha and Reservation Aloha, the FC makes the final decision. In the data transmission period the SU'S utilizes the channel for communication.

### *B. Reporting Channels Based On S-Aloha*

Slotted ALOHA was invented to improve the efficiency of pure ALOHA. In slotted ALOHA we divide the time into slots and force the secondary users to send only at the beginning of the time slot. Because a channel is allowed to send only at the beginning of the synchronized time slot, if a secondary user misses this moment, it must wait until the beginning of the next time slot. If two or more SUs choose to occupy the same slot, all reports in that slot will be lost. On the other hand, if only one user chooses a specific slot by threshold voltage, then the fusion center will receive reports successfully. FC implements the K out of N fusion rule to make a final decision considering a predefined decision threshold T.

### *C. Reporting Channels Based On R-Aloha*

The system has two modes of operation: unreserved mode and reserved mode. In the unreserved mode, the time axis is divided into short equal-length sub slots for making reservations. Fig:3 Users transmit short reservation requests in the reservation sub slots. After transmitting a reservation request a user waits for positive acknowledgment (ACK). The reservation acknowledgment advices the requesting user where to locate its first data packet. The system then switches to the reserved mode.

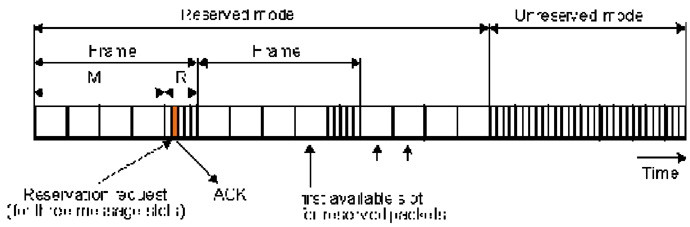


Fig.3. Frame structure of Reservation Aloha

In the reserved mode the time axis is divided into fixed-length frames. Each frame consists of M+1 equal-length slots of which the first M slots are used for message transmission (message slots) and the last slot is subdivided into R short reservation sub slots used for reservation. A sending user that has been granted a reservation sends its packets in successive message slots, skipping over the reservation sub slots when they are encountered. When there are no reservations taking place, the system returns to the unreserved mode.

## IV. METHODOLOGY

### *A. Maximize throughput*

The maximum throughput Occurs at G(n) = 1
If we knew m, n, and qa we could pick qr so that,
G(n) = (m – n) qa + nqr = 1 qr = 1 − (m − n)qa/n

### *B. Slotted Aloha*

Departure rate = Prob of 1 transmission in a slot = Ge−G
Maximum departure rate occurs at:
d/dG (Ge−G) = e −G − Ge−G = 0 G = 1
Maximum departure rate = e −1 ≈ 0. 368,
At the maximum departure rate: Pr (empty slot) = e −G = e −1 ≈. 368
Pr (successful x mission) = Ge−G = e −1 ≈. 368
Pr (collision) = 1 − e −G − Ge−G ≈ 1 − 2*. 368 =. 264
S = Ge−2G for un slotted Aloha and S = Ge−G for slotted Aloha

### *C. Average Delay*

The average number of times a source transmits is G S
The average number of times a source retries, when there is an equilibrium point, is R = (G/S – 1)
$R_{unslotted}$ = e 2G – 1
$R_{slotted} = e^{G} - 1$
At G = $G_{max}$, R = e − 1, for both systems
If the average time between retries is W, the average delay is T = 1 + R (1 + W)

## V. SIMULATION RESULT

Ns2 has been used as simulation platform to evaluate the performance of the new algorithm protocol.

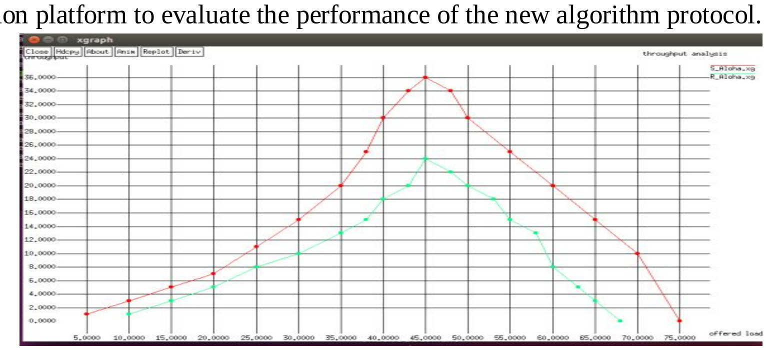

Fig.4. Throughput analysis

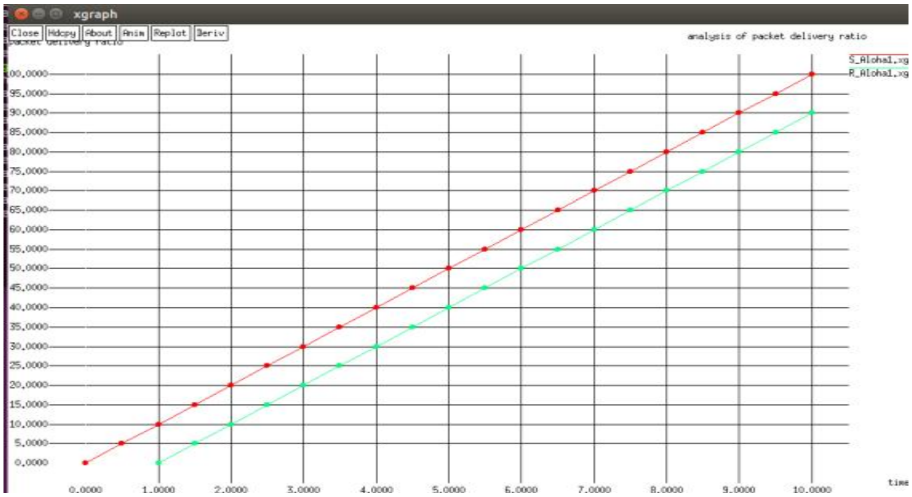


Fig.5. ANALYSIS OF PACKET DELIVERY RATIO

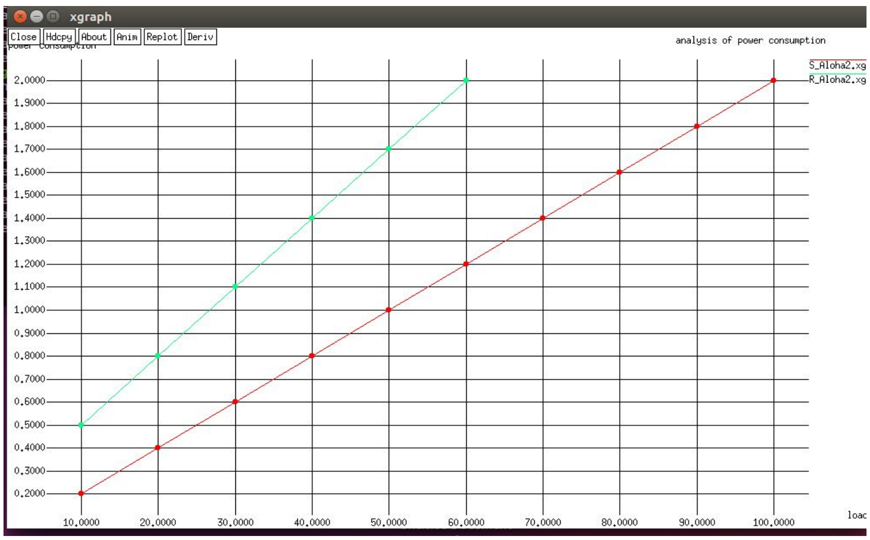


Fig.6. Analysis of power consuption

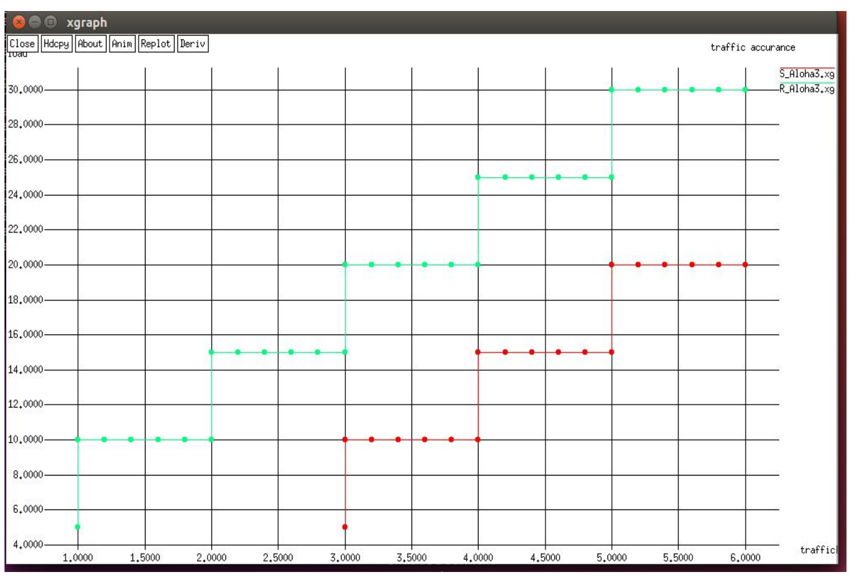


Fig.7. Analysis of traffic occurance

## VI. CONCLUSION

A reporting channel design approach for cooperative spectrum sensing cognitive radio networks. This reporting channel design approach is based on random access protocols, including S-Aloha and R-Aloha. This approach is utilized to reduce channel assignment complexity in any fixed assignment reporting channel design. Analytical evaluations and performance comparisons are performed considering Random access protocols. With various design parameters and hard/soft fusion rules, it is shown that good cooperative spectrum sensing performance and higher throughput, packet delivery ratio is achieved with limit number of reporting slots. It is also observed that, in general, Random access protocols performs better than previous approaches like fixed assignment scheduling protocols in providing effective reporting channels. Future work to increases the throughputs “original” frames generated at all nodes of a contention-based network (ALOHA, CSMA, etc.) per unit time.

## REFERENCES

[1] Sedat Atmaca, Omer Sayli, Jin Yuan and Adnan Kavak, “Throughput Maximization of CSMA in Cognitive Radio Networks with Cooperative Spectrum Sensing”, Springer Science+Business Media New York, DOI 10.1007/s11277-016-3616-y, 2016.
[2] Raed Alhamad, Huaxia Wang and Yu-Dong Yao, “Cooperative Spectrum Sensing with Random Access Reporting Channels in Cognitive Radio Networks,” IEEE Transactions on Vehicular Technology, DOI 10.1109/TVT.2017.2657485., 0018-9545 (c) 2016.
[3] J. Lundn, M. Motani, and H. V. Poor, “Distributed Algorithms for Sharing Spectrum Sensing Information in Cognitive Radio Networks”, IEEE Transaction Wireless Communication, vol. 14, no. 8, pp. 4667-4678, Aug. 2015.
[4] Won-yeol Lee and Ian. F. Akyildiz, “Optimal spectrum sensing framework for cognitive radio networks”, IEEE Transactions on wireless communications, VOL. 7, NO. 10, sept. 2015.
[5] Y. Zou, Y.-D. Yao, and B. Zheng, “A selective-relay based cooperative spectrum sensing scheme without dedicated relay channels in cognitive radio networks,” IEEE Trans. Wireless Commun., vol. 10, no. 4, pp. 1188-1198, Apr. 2011.
[6] J. Ma, G. Zhao, and Y. Li, “Soft combination and detection for cooperative spectrum sensing in cognitive radio networks,” IEEE Trans. Wireless Commun., vol. 7, no. 11, pp. 4502-4507, Nov. 2008.
[7] A.Ghasemi and E. Sousa, “Collaborative spectrum sensing for opportunistic access in fading environment,” in Proc. IEEE DySPAN, Nov. 2005, pp. 131-136.
[8] D. Cabric, A. Tkachenko, and R. W. Brodersen, “Experimental study of spectrum sensing based on energy detection and network cooperation,”in Proc. ACM 1st Int. Workshop on Technology and Policy for Accessing Spectrum (TAPAS), Aug. 2006.
[9] G. Ganesan and Y. Li, “Cooperative spectrum sensing in cognitive radio networks,” in Proc. IEEE DySPAN, Nov. 2005, pp. 137-143.
[10] J. Mitola, “Cognitive radio: An integrated agent architecture for software defined radio,” Doctor of Technology, Royal Inst. Technol. (KTH), Stockholm, Sweden, May 2000.