Avoid Spectrum Scarcity by Using Dynamic Spectrum Access and Sequence Based Rendezvous Method

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Abstract –Cognitive broadcasting network (CRN) is used to solve the underutilization problem of licensed spectra and overcome spectrum scarcity. Each secondary user has the capability to detect the spectrum holes and operate on these channels. As Enhanced Alternative Hop and Wait will generate a unique alternate CH series for each Secondary User to hop on, Secondary users need to be assigned unique IDs for identifying. The problem formulation intends to develop a new blind rendezvous method which can thoroughly satisfy the blind rendezvous criteria with shorter TTR. The design considerations are Asynchronous environment, Rendezvous guarantee, Asymmetric model, Heterogeneous of roles, Rendezvous performance. The rendezvous guarantee Secondary users that any two Secondary users can rendezvous within finite time slots. In this paper, to easily verify the performance of blind rendezvous methods, both the source secondary users and target secondary users are Secondary user to be available in the system. The time slotted communication system important to provide both shorter TTR and more rendezvous in a time unit. Secondary users have to discover the number of available channels of its target which is hard to achieve. Enhanced Alternative Hop and Wait has the smallest standard deviation of rendezvous interval, which indicates the transmission jitter is lower and communication is stable. A small standard deviation of channel access times shows that Enhanced Alternative Hop and Wait uses all common channels equally, which not only can avoid the single point of failure problem but also use the broadband resource efficiently.

Index Terms – Cognitive broadcasting network, blind rendezvous, channel hopping.

1. INTRODUCTION

One of the Commission's key spectrum management goals has been to promote efficient access to and use of the radio spectrum. Spectrum Policy Statement indicated that "with increased demand for a finite supply of spectrum, the Commission's spectrum management activities must focus on allowing spectrum markets to become more efficient and increasing the amount of spectrum available for use. Demand for access to spectrum has been growing dramatically, and is likely to continue to grow for the foreseeable future. New services, such as unlicensed wireless internet access and satellite digital audio broadcasting, are being launched and are quickly reaching hundreds of thousands of consumers. To ensure the existing services can continue to grow and evolve to serve marketplace needs, and that new services have a chance to blossom and grow, it is important that the Commission continue to promote efficient access to and use of the radio spectrum. Cognitive Radio (CR) is commonly considered a key enabling technology to provide high bandwidth to mobile users via heterogeneous wireless architectures and Active Spectrum Access (DSA) capabilities. Broadly speaking, a CR can be defined as "an intelligent wireless communication device that exploits side information about its environment to improve spectrum utilization", and is likely to consist of several components, but mainly of a sensing, decision, and execution unit. In the light of the above definition of CR, there is a common understanding in the research community that a fundamental element for the successful exploitation of interweave CRs is the design of robust spectrum sensing methods to detect licensee users transmitting over a given frequency band. Among the various proposals, cooperative spectrum sensing methods using energy–based detectors in each cooperative user are often considered a good candidate to enable CR functionalities, as they provide a good trade–off for keeping the complexity of every cooperative node at a moderate level, as well as counteracting the limitations of energy–based detection in the low Signal–to–Noise Ratio (SNR) regime via distributed diversity. Generally, user can use radio spectrum only after obtaining individual license issued by national regulatory agency. In technical point of view, this approach helps in system design since it is easier to make a system that operates in a dedicated band than a system that can use many different bands over a large frequency range. Furthermore in national. Spectrum assignment databases almost all frequency bands of commercial or public interest are already licensed.

2. RELATED WORK

All C. Cordeiro [4] This paper describes the Current wireless networks are based on a fixed spectrum assignment policy that is regulated by governmental agencies. Although spectrum is licensed on a long-term basis over vast geographical regions, recent research has shown that significant portions of the assigned spectrum are utilized, leading to waste of valuable frequency resources. To address this critical problem, the FCC recently approved the use of unlicensed devices in licensed bands. In CRAHNs CR users are mobile and can communicate with each other in a multi hop manner on both licensed and unlicensed spectrum bands.I.F. Akyildiz [3]

A spectrum hole (or also called white space) is a band of frequencies assigned to a primary user, but at a particular time and specific geographic location, the band is not being utilized by that user. Spectrum hole concept can be further generalized as transmission opportunity in radio spectrum space. Radio spectrum space is a theoretical hyperspace occupied by radio signals which has dimensions of location, angle of arrival, frequency, time, energy and possibly others. A radio build on cognitive radio concept have the ability to sense and understand its local radio spectrum environment, to identify spectrum holes in radio spectrum space, to make autonomous decisions about how it accesses spectrum and to adapt its transmissions accordingly. Such cognitive radio using active spectrum access has the potential to significantly improve spectrum efficiency utilization resulting in easier and flexible spectrum access for current or future wireless services. K. Bian [8] conventionally, an ad hoc cognitive broadcasting network (CRN) is designed to support communications among a small group of users who are acquaintances/friends to each other.

However, various wireless devices have recently been made spectrum agile, allowing a large-scale ad hoc CRN to be formed between “stranger” Secondary user. This CRN formed with stranger devices is useful or necessary for many applications and is likely to contain heterogeneous devices with different sensing capabilities. For example, in a disaster stricken area, people should be able to opportunistically use any wireless devices available to share and send/receive emergency messages. C. Cordeiro [10] The IEEE 802.22 activity is the first worldwide effort to define a standardized air interface based on CR techniques for the opportunistic use of TV bands on a non-interfering basis. Due to this fact, the work being done in IEEE 802.22 is in many respects unique and the first of its kind, with little relevant related work. Its development process is a combined effort of traditional companies as well as representatives from the incumbent community (TV broadcasting and Wireless Microphones), and is scheduled to produce version 1.0 of the draft standard around January 2007. C. Kim [12] The quorum-based scheme was proposed for CCC establishment in CR networks. The channel hopping series (CHS) is constructed from quorum systems which satisfy the intersection property and increase the degree of overlap between series. The A-MOCH system assumes at least one commonly available channel utilizing the rotation closure property of quorum systems to enable at least one rendezvous in N^2time slots, where N is the total number of channels.

3. THE IEEE 802.22 SYSTEM

The major push towards the commercial deployment of CRs is coming mostly from the US; the goal of IEEE 802.22 is to define an international standard That may operate in any regulatory regime. Therefore, the current 802.22 project identifies the North American frequency range of operation from 54-862 MHz, while There is an ongoing debate to extend the operational range to 41-910 MHz as to meet additional international regulatory requirements. Also, the standard shall accommodate the various international TV channel bandwidths of 6, 7, and 8 MHz. The 802.22 system specifies a fixed point-to-multipoint (P-MP) wireless air interface whereby a base station (BS) manages its own cell2 and all associated Consumer Premise Equipments (CPEs), as depicted in.

The BS controls the medium access in its cell and transmits in the downstream direction to the various CPEs, which respond back to the BS in the upstream direction. In addition to the traditional role of a BS, it also manages a unique feature of distributed sensing. This is needed to ensure proper incumbent protection and is managed by the BS, which Instructs the various CPEs to perform distributed measurement of different TV channels. Based on the feedback received, the BS decides which steps, if any, are to be taken. The 802.22 system specifies spectral efficiencies in the range of 0.5 bit/(sec/Hz) up to 5 bit/(sec/Hz). If we consider an average of 3 bits/sec/Hz, this would correspond to a total PHY data rate of 18 Mbps in a 6 MHz TV channel. In order to obtain the minimum data rate per CPE, a total of 12 simultaneous users have been considered which leads to a required minimum peak throughput rate at edge of coverage of 1.5 Mbps per CPE in the downstream direction. In the upstream direction, a peak throughput of 384 kbps is specified, which is comparable to DSL services.

Another distinctive feature of 802.22 WRAN as compared to existing IEEE 802 standards is the BS coverage range, which can go up to 100 Km if power is not an issue

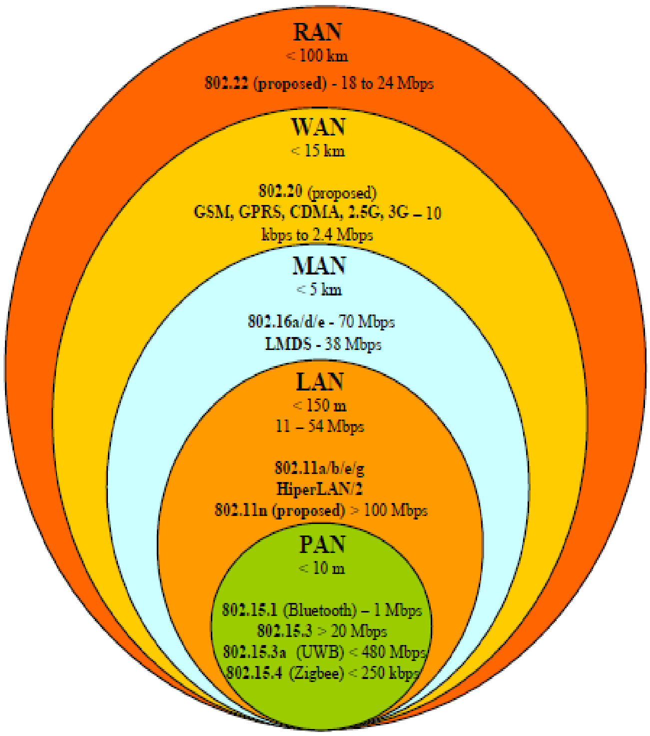

Figure 1. 802.22 wireless RAN classification as compared to other popular wireless standards

4. PROPOSED METHODOLOGY

The rendezvous behavior among Secondary user in a CRN was modeled as a phenomenon of alternate hoping and waiting among the Secondary user circumnavigating along a circle on which each vertex represents a channel indexed by the corresponding channel number of this channel.

4.1. Enhanced Alternate Hop-And-Wait Channel Hopping Method

Walking along the circle, Secondary user can be regarded as on hopping to pass through all channels by a specific series. Now, assume there are two Secondary user randomly standing on two vertices in the circle. If one of them starts to walk along the circle by one vertex per time slot and the other remains, both Secondary user must rendezvous before the former SU walks around the circle, as proved in Lemma 1. In this case, we call the former SU is in HOP mode and the later one in WAIT mode. Based on this concept, each SU performs enhanced alternative hop and wait to generate an alternate CH series as illustrated in Fig. An alternate CH series is formed with several inner alternate CH series composed of elementary CH series, and each elementary CH series is divided into three CH subseries The entire proposed was modeled as a phenomenon of alternate hoping and waiting among the Secondary user circumnavigating along a circle

4.2. Channel Hopping Subseries

There are two modes of CH subseries, HOP-mode and WAIT-mode, and each CH subseries lasts P time slots. When a secondary user intends to generate CH subseries, several parameters are needed to be decided.

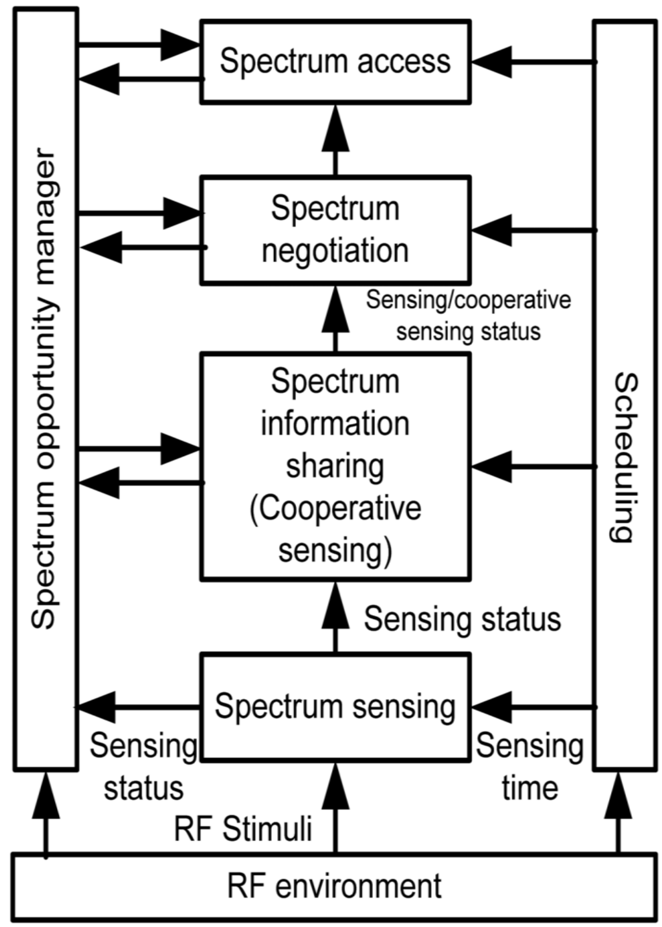

Figure 2. Logical framework of spectrum management

In enhanced alternative hop and wait, different Secondary user have to hop on diverse alternate CH series so it is must that each SU has a unique ID to derive the corresponding alternate CH series. Generally, the length of ID series is related to the number of Secondary user. However, estimating the accurate number of Secondary user in CRNs is inapplicable, and thus it is hard to determine a suitable length for ID series. Because IEEE 802.22 uses a 48-bit universal MAC address to identify users, these MAC addresses are exploited to generate the unique IDs of the Secondary user in this study. As shown in Figure ,

WRANs have a much larger coverage range than today's networks, which is primarily due to its higher power and the favorable propagation characteristics of TV frequency bands. This enhanced coverage range offers unique technical challenges as well as opportunities. By this scheme, most network devices can be identified so Enhanced alternative hop and wait is feasible to active networks. However, if the MAC address of an SU is applied as its ID directly, because the ID will be rotated continuously to generate the alternate CH series, it may be the same as that of another SU due to the asynchronous problem.

4.3. Evaluation of TTR Under The Symmetric Model

Under the symmetric model, because the rendezvous is guaranteed within an inner alternate CH series, the MTTR of enhanced alternative hop and wait is 147P, which is the length of an inner alternate CH series. To evaluate E(TTR), all cases in Table 3 should be analyzed based on the six possible conditions specified, where each of the conditions and has the same occurrence probability 1/3P, whereas each of the conditions and has the probability 1P=3P. enhanced alternative hop and wait supports not only HOP-WAIT type rendezvous but also the HOP-HOP type one proposed in MC.

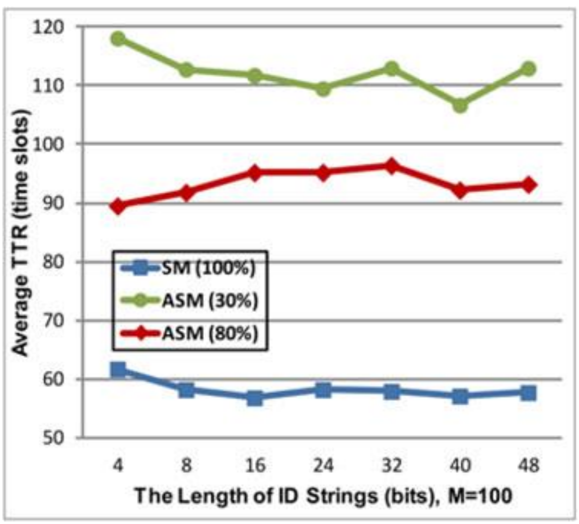

Figure 3. The variation of average TTR of enhanced alternative hop and wait under various lengths of ID series.

However, the HOP-HOP type rendezvous only works when the two Secondary user have different CH distance. Thus for the following, the analysis was performed separately. When the CH distances of the two Secondary user are different, both the HOP-WAIT and HOP-HOP types are considered. However, when their CH distances are identical, only HOP-WAIT type is calculated. The BS controls the medium access in its cell and transmits in the downstream direction to the various CPEs, which respond back to the BS in the upstream direction. In addition to the traditional role of a BS, it also manages a unique feature of distributed sensing.

5. EXPERIMENTAL RESULTS

The common CH use rate of all methods is 100 percent, indicating that all common channels are used by each method. The reason is, for all unavailable channels, the random-replace operation selects alternative channels randomly giving all common channels the same probability to be used. For all methods, the average numbers of channel access times per common channel within 147PM time slots and their standard deviation. Enhanced Alternative Hop and Wait has the most average CH access times indicating the most optimal performance among all methods. Also, a small standard deviation of channel access times shows that enhanced alternative hop and wait uses all common channels equally, which not only can avoid the single point of failure problem but also use the radio resource efficiently.

6. CONCLUSION

In this paper, enhanced alternative hop and wait exploited the ID information to achieve rendezvous, in the following simulation, the influence caused by various designs of ID series, which indicates different lengths of ID series, is discussed. TTR indicates the number of time slots that an SU takes for a rendezvous. Maximum TTR (MTTR) and expected TTR (E(TTR)) are two common criteria to evaluate the rendezvous presentation, which designate the the pits and usual TTR case for security rendezvous. As presented the theoretical analysis proves that enhanced alternative hop and wait has shorter MTTR and E (TTR) than presented methods. The poorer bound of the number of rendezvous in a given time slot and the standard deviation of the TTR between two rendezvous were also derived.

REFERENCES

[1] Federal Communications Commission, "Spectrum Policy Task Force Report," ET Docket no. 02-155, Nov. 2002.
[2] A. Ghasemi and E.S. Sousa, "Spectrum Sensing in Cognitive broadcasting networks: Requirements, Challenges and Design Trade-Offs," IEEE Comm. Magazine, vol. 46, no. 4, pp. 32-39, Apr. 2008.
[3] I.F. Akyildiz, L. Won-Yeol, M.C. Vuran, and S. Mohanty, "A Survey on Spectrum Management in Cognitive broadcasting networks,"
[4] IEEE Comm. Magazine, vol. 46, no. 4, pp. 40-48, Apr. 2008.
[5] C. Cordeiro, K. Challapali, D. Birru, and N. Sai Shankar, "IEEE 802.22: The First Worldwide Wireless Standard Based on Cognitive Radios," J. Comm., vol. 1, no. 1, 2006.
[6] 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.
[7] L. Ma, X. Han, and C.-C. Shen, "ActiveOpen Spectrum Sharing for Wireless Ad Hoc Networks," Proc. IEEE First Int'l Symp. New Frontiers in ActiveSpectrum Access Networks (DySPAN), 2005.

[8] A. Sampath, D. Hui, Z. Haitao, and B.Y. Zhao, "Multi-Channel Jamming Attacks Using Cognitive Radios," Proc. 16th Int'l Conf. Computer Comm. and Networks (ICCCN), 2007.

[9] K. Bian and J.-M Park, "Asynchronous Channel Hopping for Establishing Rendezvous in Cognitive broadcasting networks," Proc. IEEE INFOCOM, 2011.

[10] C. Stevenson, G. Chouinard, Z. Lei, W. Hu, S. Shellhammer, and W. 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.

[11] C. Cordeiro, K. Challapali, and D. Birru, "IEEE 802.22: An Introduction

[12] to the First Wireless Standard Based on Cognitive Radios," J. Comm., vol. 1, no. 1, pp. 38-47, Apr. 2006.

[13] N.C. Theis, R.W. Thomas, and L.A. DaSilva, "Rendezvous for Cognitive Radios," IEEE Trans. Mobile Computing, vol. 10, no. 2, pp. 216-227, Feb. 2011.

[14] D. Yang, J. Shin, and C. Kim, "Deterministic Rendezvous Scheme in Multichannel Access Networks," Electronics Letters, vol. 46, no. 20, pp. 1402-1404, 2010.