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Efficient Resource Allocations for Spectrum Leasing in Cooperative Cognitive Radio Networks

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Abstract: Cooperative Cognitive Radio Networks (CCRNs) incorporates cooperative communication into psychological feature radio networks, in which, primary users lease their spectrum to secondary users, and in exchange, the first users leverage secondary users as cooperative relays to boost their own turnout. Mobile operators offload their net traffic to in private in hand Wi-Fi access points (APs), a lot of to the inconvenience of non-cellular users served by the APs. However, by using the CCRN theme, the mobile operator will lease a commissioned channel to the AP, effectively doubling its capability. During this paper, propose Associate in nursing implementation of the CCRN framework applied to IEEE 802.11 WLANs. The cooperation is solid as a 2 player negotiation game wherever the 2 players' ar the first users (users of the mobile operator) and also the secondary users (users of the AP before spectrum leasing) WHO cut price for either turnout share or channel time interval share. The best resource allocation that ensures potency likewise as fairness among users is provided by the Nash solution. Simulation results show that the users succeed higher turnout via the planned CCRN theme, so providing the mobile operator (e.g., AT&T) and also the personal Wi-Fi supplier (e.g., a Starbucks low shop) with incentives for cooperation.

KEYWORDS: Cooperative Cognitive Radio Networks (CCRNs), Access Points (APs), WLAN, Security, Privacy

I. INTRODUCTION

Mobile computing is human–computer interaction by which a computer is expected to be transported during normal usage. Mobile computing involves mobile communication, mobile hardware, and mobile software. Communication issues include ad hoc and infrastructure networks as well as communication properties, protocols, data formats and concrete technologies. Hardware includes mobile devices or device components. Mobile software deals with the characteristics and requirements of mobile applications.

Mobile Computing is "taking a computer and all necessary files and software out into the field. Mobile computing is any type of computing which use Internet or intranet and respective communications links, as WAN, LAN, WLAN etc. Mobile computers may form wireless or a pioneer.

Many types of mobile computers have been introduced since the 1990s including the:

- Portable computer (discontinued)
- Personal digital assistant/Enterprise digital assistant (discontinued)
- Ultra-Mobile PC (discontinued)
- Laptop
- Smartphone
- Tablet computer
- Wearable computer
- Computer

In- vehicle computing and Fleet Computing

Many commercial and government field forces deploy a ruggedized portable computer with their fleet of vehicles. This requires the units to be anchored to the vehicle for driver safety, device security, and ergonomics. Rugged computers

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are rated for severe vibration associated with large service vehicles and off-road driving and the harsh environmental conditions of constant professional use such as in emergency medical services, fire, and public safety.

Other elements affecting function in vehicle:

- Typical fan-based cooling has stated limits of operating temperature: A vehicle cabin can often experience temperature swings from -20F to +140F. Computers typically must be able to withstand these temperatures while operating.
- 95F-100F of ambient temperature and temperatures below freezing require localized heaters to bring components up to operating temperature (based on independent studies by the SRI Group and by Panasonic R&D).
- Vibration can decrease the life expectancy of computer components, notably rotational storage such as HDDs. Visibility of standard screens becomes an issue in and navigation equipment.
- Bright sunlight Touch screen users easily interact with the units in the field without removing gloves. High-temperature battery settings: Lithium ion batteries are sensitive to high temperature conditions for charging. A computer designed for the mobile environment should be designed with a high-temperature charging function that limits the charge to 85% or less of capacity.
- External antenna connections go through the typical metal cabins of vehicles which would block wireless reception, and take advantage of much more capable external communication Several specialized manufacturers such as First Mobile Technologies, National Products Inc (Ram Mounts), Gambler Johnson and Lecco build mounts for vehicle mounting of computer equipment for a wide range of vehicles.
- The mounts are built to withstand the harsh conditions and maintain ergonomics. Specialized installation companies design the mount design, assembling the parts, and installing them in a safe and consistent manner away from airbags, vehicle HVAC controls, and driver controls. Frequently installations will include a WWAN modem, power conditioning equipment, transceiver antennae mounted external to the vehicle, and WWAN/WLAN/GPS/etc.

Portable computing devices

- Several categories of portable computing devices can run on batteries but are not usually classified as laptops: portable computers, PDAs, ultra mobile PCs (UMPCs), tablets and smart phones.
- A portable computer (discontinued) is a general-purpose computer that can be easily moved from place to place, but cannot be used while in transit, usually because it requires some "setting-up" and an AC power source. The most famous example is the Osborne 1. Portable computers are also called a "transportable" or a "luggable" PC.
- A personal digital assistant (PDA) (discontinued) is a small, usually pocket-sized, computer with limited functionality. It is intended to supplement and to synchronize with a desktop computer, giving access to contacts, address book, notes, e-mail and other features.
- An ultra mobile PC (discontinued) is a full-featured, PDA-sized computer running a general-purpose operating system.
- A tablet computer that lacks a keyboard (also known as a non-convertible tablet) is shaped like a slate or a paper notebook. Instead a physical keyboard it has a touch screen with some combination of virtual keyboard, stylus and/or handwriting recognition software. Tablets may not be best suited for applications requiring a physical keyboard for typing, but are otherwise capable of carrying out most of the tasks of an ordinary laptop.
- A smart phone has a wide range of features and install-able applications.
- A carpeted is installed in an automobile. It operates as a wireless computer, sound system, GPS, and DVD player. It also contains word processing software and is Bluetooth compatible.
- A Pen top (discontinued) is a computing device the size and shape of a pen. It functions as a writing utensil, MP3 player, language translator, digital storage device, and calculator
- Boundaries that separate these categories are blurry at times. For example, the OQO UMPC is also a PDA-sized tablet PC; the Apple e Mate had the clamshell form factor of a laptop, but ran PDA software. The HP Omni book line of laptops included some devices small more enough to be called ultra mobile PCs. The hardware of the Nokia 770 internet tablet is essentially the same as that of a PDA such as the Azures , both the 770 and the Azures can run some desktop Linux software, usually with modifications. 6000; the only reason it's not called a PDA is that it does not have PIM software.

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Mobile Data Communication

Wireless data connections used in mobile computing take three general forms. Cellular data services use a technology such as GSM, CDMA or GPRS 3G networks such as EDGE or CDMA2000. And more recently 4G networks such as LTE, LTE-Advanced. These networks are usually available within range of commercial towers. Wi-Fi connections offer higher performance, may be either on a private business network or accessed through public hotspots, and have a typical range of 100 feet indoors and up to 1000 feet outdoors. Satellite Internet access covers areas where cellular and Wi-Fi are not available and may be set up anywhere the user has a line of sight to the satellite's location, which for satellites in geostationary orbit means having an unobstructed view of the southern sky. Some enterprise deployments combine networks from multiple cellular networks or use a mix of cellular, Wi-Fi and satellite. When using a mix of networks, a mobile virtual private network (mobile VPN) not only handles the security concerns, but also performs the multiple network logins automatically and keeps the application connections alive to prevent crashes or data loss during network transitions or coverage loss.

II. RELATED WORK

The major part of the project development sector considers and fully survey all the required needs for developing the project. Before developing the tools and the associated designing it is necessary to determine and survey the time factor, resource requirement, man power, economy, and company strength. Once these things are satisfied and fully surveyed, then the next step is to determine about the software specifications in the respective system such as what type of operating system the project would require, and what are all the necessary software are needed to proceed with the next step such as developing the tools, and the associated operations.

A. *Exploiting MIMO Antennas in Cooperative Cognitive Radio Networks*

Cognitive radio with the aptitude to flexibly adapt its transmission or reception parameters, has been planned because the suggests that for unaccredited secondary users (SUs) to dynamically access the commissioned spectrum command by primary users (PUs) so as to extend the potency of spectrum utilization. Recently, a replacement paradigm termed Cooperative psychological feature Radio Networks (CCRNs) has been advocated. In CCRN, PUs could choose some Sus to relay the first traffic hand in glove and reciprocally grant portion of the channel interval to the Sus. By exploiting cooperative diversity, the transmission rates of PUs are often considerably improved. SUs, being the cooperative relays, as a consequence acquire opportunities to access the channel for his or her own knowledge transmissions equipped with one antenna. Especially, frame durations time-divided into 3 phases. The primary section is employed for the first transmitter to broadcast the info to the relaying Sus. Within the second section, those Sus type a distributed antenna array to hand in glove relay the first knowledge to the first receiver, raising the turnout of the first link. In return, the third section is hired to the Sus for his or her own traffic. Though the standard CCRN framework edges each the PUs and Sus, there still exists some unskillfulness. First, the chemical element should fully provide out its spectrum access to the Sus for his or her transmissions within the third section, as a gift for the Sus to assist relay the first knowledge. To incentivize the Sus to participate within the cooperation, the length of the third section ought to be set moderately giant so the through place that the Sus will earn may compensate the ability they need consumed within the previous relay transmission. This introduces high overhead to the PUs' communication. Second, the SUs' transmissions square measure confined to the third section. Considering there'll be multiple secondary links competitor for spectrum access, this section can become huddled. As a result, the turnout every secondary link is able to do is proscribed.

B. *Cooperative Cognitive Radio Networking*

CRNs (Cooperative radio Networking) have 2 variety of parts that theme primary network and a secondary network, either of which may be in an advert hoc mode or AN infrastructure mode. Cooperation totally different completely different}|for various} network architectures poses different challenges and has different options. Cooperation between 2 infrastructure networks is studied in. In cooperation is studied underneath the situation consisting of AN infrastructure primary network and an infrastructure secondary network, wherever the PUs communicates with the first base station and mammal genus communicate with the secondary base station. The target of cooperation is developed as a weighted total output maximization downside, Security-aware Cooperation in psychological feature Radio Networks, Cooperative psychological feature Radio Networking closed-form solutions of

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the optimum power setting allocation ar obtained for the amplify-and-forward and decode-and-forward relaying modes, severally. In the authors take under consideration that each active and inactive PUs be within the primary network, and propose 2 straightforward cooperation frameworks that ar capable of stimulating each active and inactive PUs, and mammal genus to participate in cooperation to attain mutual edges. Specifically, for active PUs, mammal genus will relay PUs' packets and obtains transmission opportunities as a gift. For inactive PUs, neighbor mammal genus will lease spectral bands along from inactive PUs, and perform cooperative communication with one another. In, the cooperation is taken into account for a situation, wherever the first network is AN infrastructure network and therefore the secondary network is an advert hoc network. Multiple mammal genus vie with one another to maximize their own utilities via cooperation with the chemical element and therefore the chemical element selects the simplest SU with that it are able to do the utmost utility.

C. ***A Stackelberg Game for Spectrum Leasing in Cognitive Radio Networks***

Cognitive radio, primary users (PUs) World Health Organization own the spectrum resource have the correct to lease a part of spectrum to secondary users (SUs) in exchange for acceptable. During this paper, we have a tendency to propose a pricing-based spectrum leasing framework between one Pu and multiple Sus. During this situation, the Pu makes an attempt to maximize its utility by setting the worth of spectrum. Then, the chosen Sus have the correct to make a decision their power levels to assist PU0s transmission, progressing to get corresponding interval. The spectrum leasing downside is forged into a stacked berg game, wherever the Pu plays the seller-level game and also the elect Sus play the buyer-level game. Through analysis supported the backward induction, we have a tendency to prove that there exists a novel equilibrium within the stackelberg game with bound constraints.

Numerical results show that the planned pricing-based spectrum leasing framework is effective, and also the performance of each Pu and Sus is improved, compared to the standard mechanism while not cooperation. For distributed resource allocation, CSI isn't required. And theory of games is a good methodology to check the behavior of users in distributed schemes furthermore, rating mechanism was introduced to boost the economical of Nash equilibrium Power management supported rating was accustomed optimize the Pu utility studied the spectrum commercialism with Pu and Sus and modeled the commercialism method as a monopoly market.

Within the PUs transmission rate was maximized supported theory of games. With a signal/noise rate (SNR) constraint, a distributed power management formula was planned to permit all Sus to access the channel at an equivalent time. In a very game-theoretical framework was planned to research a power-adaptive cooperation mechanism in psychological feature radio networks. However, the SUs0 performance demand and power consumption for transmission its own info weren't taken into thought. In our model, we have a tendency to specialize in distributed resource allocation within the property-rights model, and propose a pricing-based spectrum leasing framework, that permits the exchange between spectrum and power in psychological feature radio web we have a tendency to propose a completely unique rating model for spectrum leasing in secondary spectrum market, and also the rating model is thought-about as a mechanism enabling the exchange between spectrum and power. The Pu makes an attempt to maximize its utility by setting the worth of spectrum. Then, the chosen Sus have the correct to make a decision their power levels to assist PUs transmission, progressing to get corresponding interval to the spectrum.

D. ***Anomalous Spectrum Usage Attack Detection in Cognitive Radio Wireless Networks***

In several mission-critical applications like military operations or disaster relief efforts, completely different organizations could collaborate on a mission and multiple wireless systems could exist in a very geographical region. Wireless networks using dynamic spectrum access enabled by psychological feature Radio (CR) technology gain quality thanks to their high spectrum potency and ability. Dynamic spectrum access permits associate unauthorized Secondary User (SU) equipped with a Cr exist with a accredited Primary User (PU) while not inflicting interference to it element. Psychological feature radio has the potential to sense a good vary of frequencies and to opportunistically use the unoccupied spectrum in a very heterogeneous atmosphere. The introduction of psychological feature radio shifts the paradigm of spectrum management from command and management to dynamic spectrum access, therefore improves the spectrum utilization dramatically. At constant time, a psychological feature radio like a JTRS radio will reconfigure its undulation on the fly, and fulfills the need of ability.

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III. PROPOSED SCHEME

CCRN framework for primary network that supports any current cellular standard, such as LTE, and an IEEE 802.11multi-rate WLAN based secondary network. The secondary AP, all users (either primary or secondary) employ an IEEE 802.11 based channel contention mechanism. Both the AP and the BS are connected to the Internet over wire line channel, as is common in the present-day deployments. To lease to the secondary network in exchange, the AP of the secondary network offloads data traffic for the primary (cellular) users in its range. To enable spectrum leasing, the AP of the secondary network is equipped with an auxiliary radio that can be tuned to the frequency of the leased channel (licensed spectrum). All the user equipments (primary and secondary) are also equipped with radios that can be tuned to the unlicensed frequency as well as the leased channel and support dual-mode (Ex. Wi-Fi þ Cellular). Spectrum leasing simplifies commercial deployment and promotes better spectrum utilization, developing a workable pricing model between the primary network (owner of the spectrum) and the secondary network (beneficiary of the leased spectrum) is not trivial. To expedite spectrum leasing in real-world deployments, researchers have recently advocated for schemes that employ spectrum leasing, not necessarily on the basis of fees or charge, but in return for improved quality-of-service of the primary network via cooperation with secondary network.
One such proposal is the new cognitive radio paradigm in termed cooperative cognitive radio networks (CCRNs).

In CCRNs, the primary users select a set of secondary users (which have better channel conditions) to relay the primary traffic cooperatively and in return the secondary users are granted channel access opportunities in the licensed (leased) spectrum. CCRNs exploit cooperative diversity in cognitive radio networks by combining cooperative communication a physical layer technology, and the spectrum leasing feature enabled by cognitive radios .In the proposed CCRN scheme, the primary network agrees to lease the channel to the AP only if the AP is offering a bargain that improves the primary network throughput. The user devices are assumed to support service differentiation (readily available for 802.11 devices implementing 802.11e). The AP has the freedom to reassign any user in either of the two WLAN cells and to assign different service weights to different users.

Advantages

- Reduce transmission time.
- Maximization network throughput.
- Time fairness and Equal channel occupancy time.

Distributed Coordination Function

Being a region of IEEE project 802, the 802.11 medium access management (MAC) is employed to support asynchronous and time finite delivery of radio knowledge packets. it's projected that a distributed coordination operate (DCF), that uses carrier sense multiple access with collision turning away (CSMA/CA) and binary slotted exponential back off, be the premise of the IEEE 802.11 LAN macintosh protocols. It proposes an output sweetening mechanism for DCF by adjusting the competition window (CW) resetting theme. Moreover, associate degree analytical model supported Markov process is introduced to cipher the improved output of 802.11 DCF. The accuracy of the model and therefore the sweetening of the projected theme area unit verified by elaborate simulations

IV. ARCHITECTURAL DESIGN

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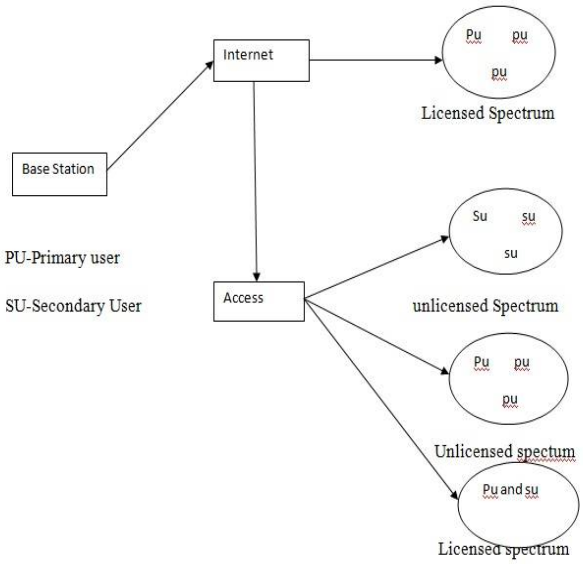

Fig.1 System Architecture

The major part of the project development sector considers and fully survey all the required needs for developing the project. Once these things are satisfied and fully surveyed, then the next step is to determine about the software specifications in the respective system such as what type of operating system the project would require, and what are all the necessary software are needed to proceed with the next step such as developing the tools, and the associated operations. Generally algorithms shows a result for exploring a single thing that is either be a performance, or speed, or accuracy, and so on. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. the behavior) between them.

The primary users initially connect to their cellular base station (BS) using cellular technology. While the secondary users connect to the IEEE 802.11 Wi-Fi AP and use the standard 802.11 DCF protocol for channel access in the unlicensed bands. The primary users with the BS form the primary network, while the secondary users along with the AP form the secondary network.

V. METHODOLOGY

Following are the most frequently used project management methodologies in the project management practice:

1. Licensed User Channel Allocations
2. Un Licensed User Channel Allocations
3. Source -to Relay wire line Channel
4. Relay-to-Destination wireless channel

1) Licensed User Channel Allocations

In this module each primary users needs to provide valid details. The primary users initially connect to their cellular base station (BS) using cellular technology such as licensed spectrum to check the available channel for sensing and to select channel and transferring data.

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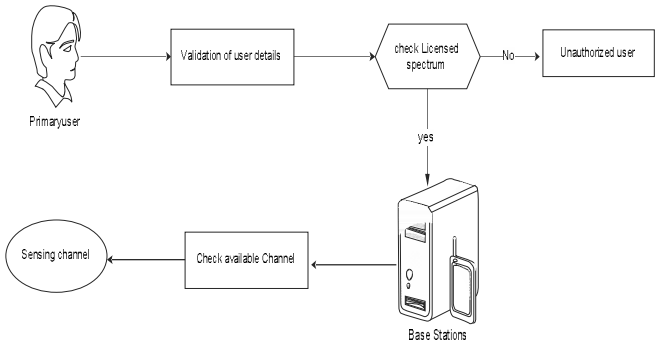

Fig.2 Licensed User Channel Allocations

2) Un Licensed User Channel Allocations

Each Secondary user to provide their valid details and verified those details. These secondary users to accessing channel with the Access Points (AP) and checking availability of users from base stations networks their sensing spectrum channel.

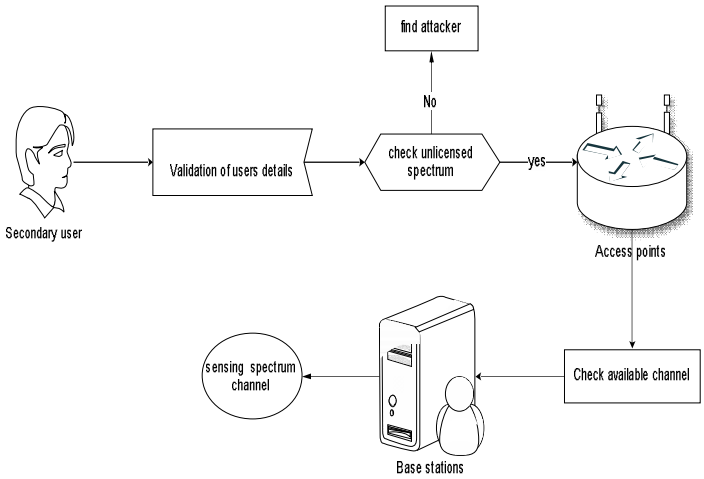

Fig.3 Unlicensed User Channel Allocations

3) Source-to-Relay Wire Line Channel

In Both primary secondary users need to provide valid details and searching their available channels to access point and sensing channel from base stations. Devices with such cognitive spectrum leasing simplifies commercial deployment and promotes better spectrum utilization, developing a workable pricing model between the primary network (owner of the spectrum) and the secondary network (beneficiary of the leased spectrum)

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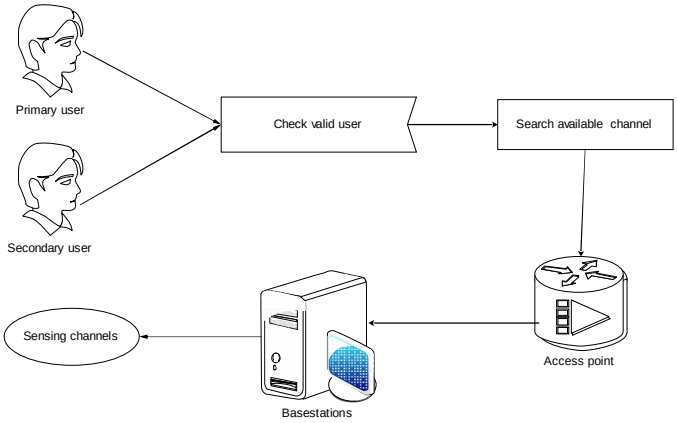

Fig.4 Source to relay wire line Channel

4) Relay-to-Destination Wireless Channel

The primary and secondary, assume that spectrum leasing is enabled via the CCRN scheme for the network. The primary network (i.e., the mobile operator) leases an additional channel from the licensed spectrum to the secondary AP. In exchange, the secondary AP adds the extra channel to its auxiliary interface and reassigns both the primary and secondary users in the two resulting WLAN cells the original cell that continues to operate in the unlicensed channel and the new cell operating in the newly leased channel.

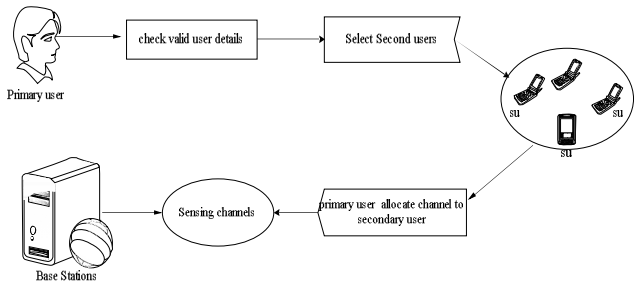

Fig.5 Relay To Destination wireless channel

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VI. SAMPLE SCREENSHOTS

Fig.6 Registration

Fig.7 Primary User Registration

Fig.8 Node Registration

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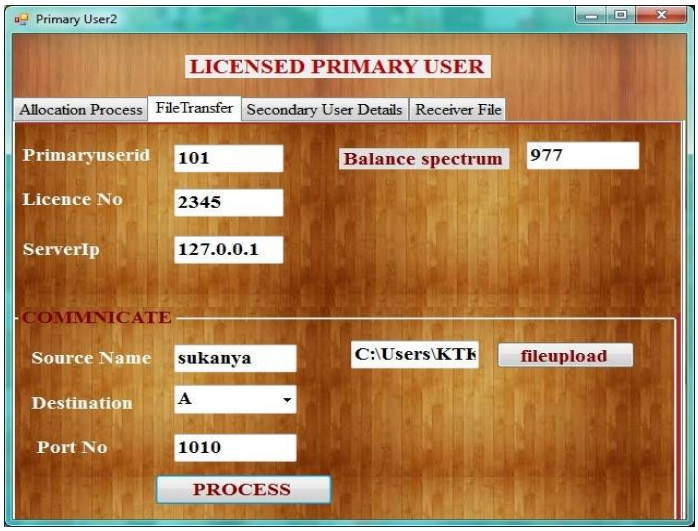

Fig.9 Primary and Node Communication

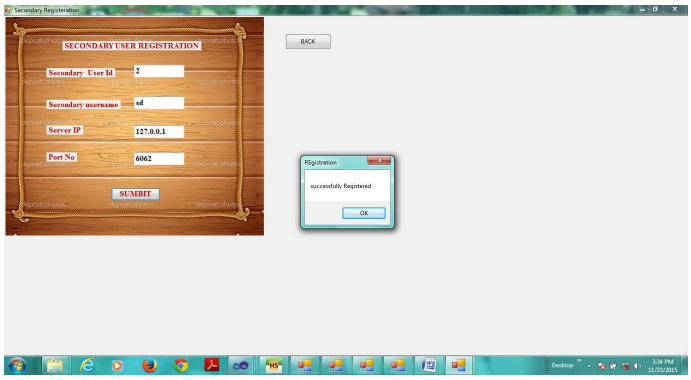

Fig.10 Secondary User Registration

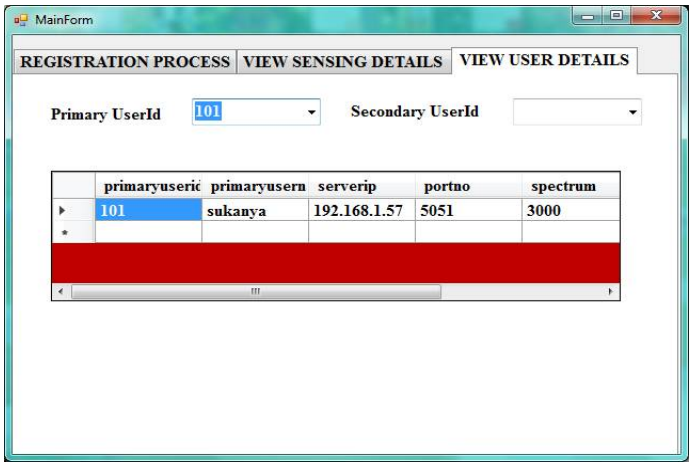

Fig.11 User Details

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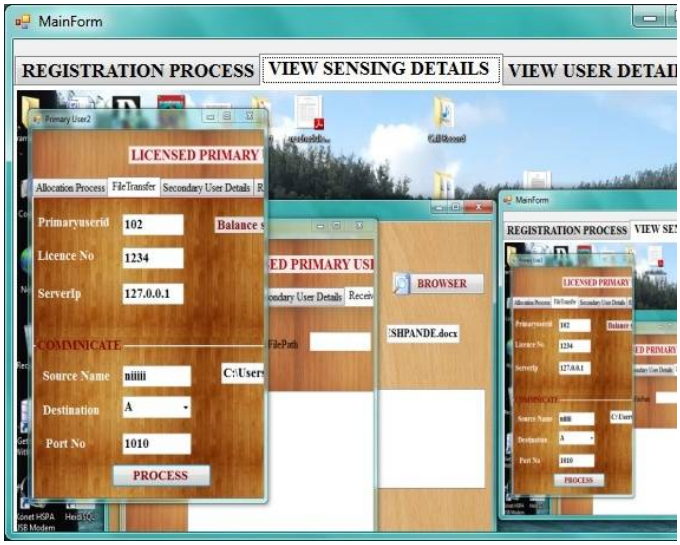

Fig.12 Sensing Details

VII. CONCLUSION

The proposed an implementation of the CCRN framework for IEEE 802.11 WLANs. In the proposed CCRN scheme, the mobile operator leases a channel from the licensed spectrum band to a privately owned Wi-Fi AP, and in return, the mobile operator leverages the AP as cooperative relays to offload its Internet traffic. The cooperation between the primary (cellular) and secondary (WLAN) networks is analyzed using a two player bargaining game where the utility function for the players are their respective aggregate network throughputs. We show that under fairness and optimal throughput constraints, the bargaining set for the bargaining game is a straight line whose slope only depends on the bit rates of the users. Calculating the Nash bargaining solution for a linear bargaining set is trivial, and the proposed CCRN algorithm determines the corresponding distribution of the users in the two WLAN and the service weights for the users at the Nash solution. The proposed computationally inexpensive WLAN model then calculates the contention window for each user that results in the operating point of the system close to the Nash solution. The simulation results verify the optimality of the operating point as well as quantify the benefits of employing the CCRN scheme in WLANs.

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