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# Improved Multi-hop Pro-active Hand-off for Cognitive Radio Network

A.VANI
Assistant Professor
CBIT
Hyderabad. India.
*e-mail:charithlakshman@gmail.com*

G.John Israel
M.E.Student
CBIT
Hyderabad. India
*e-mail: jhnisrl@gmail.com*

*Abstract* — Wireless spectrum is currently regulated by governmental agencies and is assigned to license holders or services on a long-term basis over vast geographical regions. The new area of research foresees the development of cognitive radio networks to further improve spectrum efficiency. In the proposed framework, Channel-Switching policies and a proactive spectrum handoff protocol are proposed to let unlicensed users vacate a channel before a licensed user utilizes it to avoid unwanted interference. In our base paper the main focus has been on spectrum mobility, but the effects of mobile users across multiple cells are not considered. In this paper the results of the base paper are compared with a mobile user and handoff. The simulation is done using NS2 and analysis by using Mat Lab; the results show fewer disruptions to primary transmissions by letting SUs proactively predict the future spectrum availability.

***Keywords---*** *component: Wimax, Wifi, mobility, cognitive Radio*

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## I. INTRODUCTION

Cognitive radio (CR) will lead to a revolution in wireless communication with significant impacts on technology as well as regulation of spectrum usage to overcome existing barriers. CR, including Software Defined Radio SDR as enabling technology, is suggested for the first time in and to realize a flexible and efficient usage of spectrum.There was a major emergency on 9-11 terrorist attacks in the USA. At that time communications difficulties were experienced and often a variety of radios would be needed for intercommunications, this would not be feasible for small groups of people, and reconfigurable radios would have enabled to achieve far more effective communications.

Cognitive Radio technology is a promising solution to enhance the spectrum utilization by enabling unlicensed users to exploit the spectrum in a guileful manner. Since unlicensed users are temporary visitors to the licensed spectrum, they are required to leave the spectrum when a licensed user reclaims it.

Applications in the context of CR are often included in its definition because of the compelling and unique applications afforded by CR. Additionally, there are many existing software radio techniques that CR is expected to enhance. The following are frequently advocated applications of cognitive radio:

1. Improving spectrum utilization and efficiency.
2. Improving link reliability.
3. Advanced network topologies.

The major motivation of this work is to utilize the radio spectrum more efficiently, and to be able to maintain the most efficient form of communication without interference and mobility model. The main objectives are:

1. To reduce spectrum handoff delay.
2. Improve the through-put with regional movement
3. To make continuous connectivity

The following tasks are performed to archive these objectives:

1. Understood the basics of Cognitive Radio
2. Studied the basics of spectrum handoff.
3. Developed the simulation of multiregional connectivity for CR

## II. RELATED WORK

***[1]*** In this paper author proposes light-weight cooperation in sensing based on hard decisions to mitigate the sensitivity requirements on individual radios. The CR technology allows Secondary Users (SUs) to seek and utilize “spectrum holes” in a time and location-varying radio environment without causing harmful interference to Primary Users (PUs). However, it is always harder to compared to stronger ones

[2]In this paper author suggested a new handoff scheme, HGCS, which makes effective use of the guard channels for communication. A preemptive resume priority (PRP) M/G/1 queuing network model is proposed to assess total service time for the suggested HGCS and comparing it to the existing random proactive-decision handoff scheme. There could be chances of erroneous and incorrect channel selection hence affecting the performance of Secondary Users.

[3]In this paper author proposed a new spectrum handoff approach for multiple channels cognitive radio networks to support delay sensitive applications such as VoIP. The delay probability is calculated to determine whether and how to perform the handoff operation. There could be chances of increasing the delay.

[4] In this paper author proposed intrinsic properties and current research challenges of the CRAHNs are presented. First, novel spectrum management functionalities such as spectrum sensing, spectrum sharing and spectrum decision

and spectrum mobility are introduced from the viewpoint of a network requiring distributed coordination.

CR users can communicate reliably in a distributed manner, over a multi-hop/multi-spectrum environment, without any infrastructure support. To ensure efficient spectrum-aware communication, in CRAHNs is to integrate these functions in the layers of the protocol stack and it has to face challenges like Determination of channel structure, Detection of selfish behavior and Penalizing and regulatory policing.

**[5]** In this paper author addresses the intersection of personal wireless technology and computational intelligence. The condition cognitive radio identifies the point at which personal digital assistants (PDAs) have become maximally computationally intelligent about wireless services and related computer-to-computer communications.

Cognitive radio will create radio links and etiquettes that reflect its knowledge of the radio dynamics, the user's needs, use patterns and the local environment

Not so efficient in allocating spectrum to secondary users.

[6] In this paper, author introduced a new distributed game-theoretic approach for dynamic spectrum leasing in cellular cognitive radio networks. Underutilization and scarcity of available bandwidth have led to the idea of spectrum sharing as primary users partially transfer their rights for spectrum access to others in return for rewards.

The main point of this work is to introduce different trade-offs which may be utilized to control network performance in various scenarios.

--As the network load increases, less number of users succeeds to achieve their incentives tightly.

[7] In this paper, Continuous-time Markov chains are used to model the spectrum access. The proposed three-dimensional model represents a more accurate cognitive system than the existing models with increased spectrum utilization and than the random and reservation based spectrum access.

The main point of this work is to introduce different trade-offs which may be utilized to control network performance in various scenarios.

The analysis for the non-random channel assignment was only shown.

[8] In this paper, author proposes a proactive spectrum access approach where secondary users utilize past channel histories to make predictions on future spectrum availability, and intelligently schedule channel usage in advance. Author proposes two channel selection and switching techniques to minimize disruptions to primary users and maintain reliable communication at secondary users.

The results confirm that proactive approaches can significantly reduce disruptions to primary users.

It should extend to primary user's traffic and spectrum usages have predictable patterns.

[9] In the proposed framework, channel switching policies and a proactive spectrum handoff protocol are proposed to let unlicensed users vacate a channel before a licensed user utilizes it to avoid unwanted interference.

One of the most important functionalities of CR networks is spectrum mobility, which enables SUs to change the operating frequencies based on the availability of the spectrum.

Here ignore the propagation delay or any processing time in our analysis.

[10] In this paper author proposes a learning technique for cognitive radios that will allow prediction of spectral vacancy. In order for it to be effective, the licensed signal must have periodic properties. An ideal signal would be TDMA, since it has inherent periodicity in its PHY.

Greatly reduced interference incurred by licensed signals when the predictive algorithms are used. Here there may be chance to have overheads of signals.

## III. Proposed Method

### Simulation of Cognitive Radio in NS 2

**Modules**

The major motivation of our project is to utilize the radio spectrum more efficiently, and to be able to maintain the most efficient form of communication without interference and mobility model.

To make our project work as efficient we divided our project work into small modules, such as given as bellow.

- Creating CR Network
- Spectrum selection by SU
- Channel information update
- Spectrum hand off

**Creating CR Network**

- In this first module, I am creating the network for our project.
- In this network I am setting primary users and secondary users

Meanwhile I am setting the functions of PU and SU for cognitive property. Primary users who have the right to use network resources must be protected from extra interference. On the other hand, secondary users have to be served with a minimum acceptable level of quality of service. Such QoS level may be defined based on the given application scenario.

**Spectrum Selection by SU**

Cognitive Radios have been advanced as a technology for the opportunistic use of under-utilized spectrum since they are able to sense the spectrum and use frequency bands if no Primary user is detected.

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In this second model, we are considering our primary user in two modes

- Non processing
- Processing

- Non-processing is nothing but initial processing state like users not wants to do the communication.
- In processing mode, node searching the frequency availability and select the frequency, which is available for communication

**Spectrum sensing**

A CR (secondary) user can be allocated to only an unused portion of the spectrum [8]. Therefore, a CR user should monitor the available spectrum bands, and then sense spectrum holes. Spectrum sensing is a essential functionality in CR networks, and therefore it is closely related to other spectrum management functions as well as layering protocols to provide information on spectrum availability.

**Channel Information Update**

SUs proactively predict the future spectrum availability and perform spectrum handoffs before a PU occupies the current spectrum. SUs that need to perform spectrum handoffs at the same time are required to update the predicted channel availability information with each other on the same channel [9].

- In this module, we are introducing the pro-active analyze model.
- In this module, each and every user creating the own addressing list
- The users all are updating the detail about spectrum in particular interval in own list.

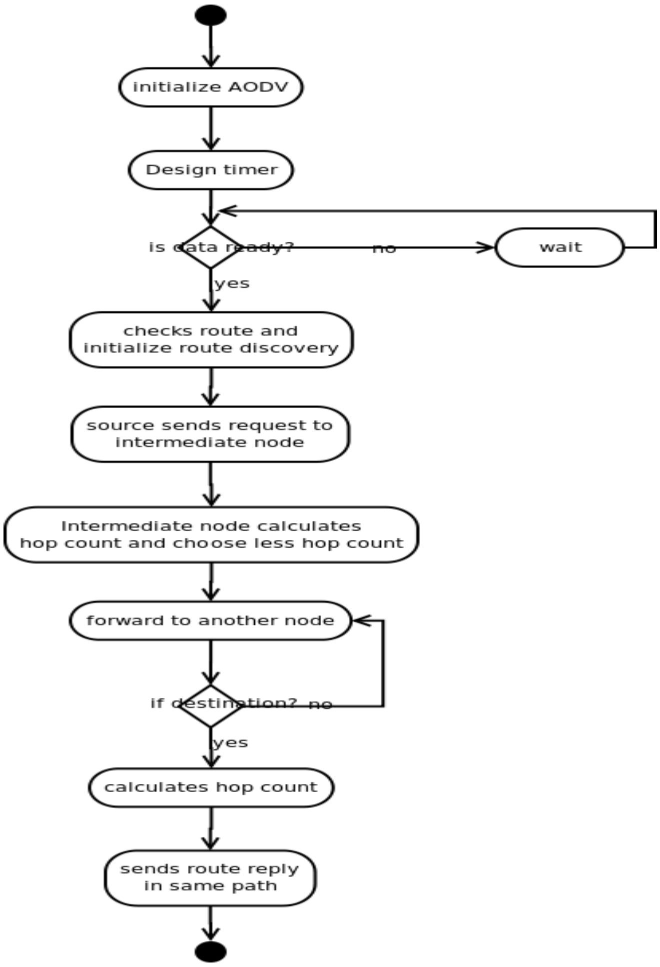
**Spectrum Hand Off**

The capabilities of CR technology can be classified into four main functionalities including spectrum sensing, spectrum decision, spectrum sharing, and spectrum mobility or spectrum handoff.

Spectrum handoff is performed for each channel individually regardless of the state of other transmissions over the other channels maintained by CR user. Licensed users are detected in one of the multiple channels and need to perform handoff. The CR user chooses a new available channel by evaluating its quality combined with the existing active channels.

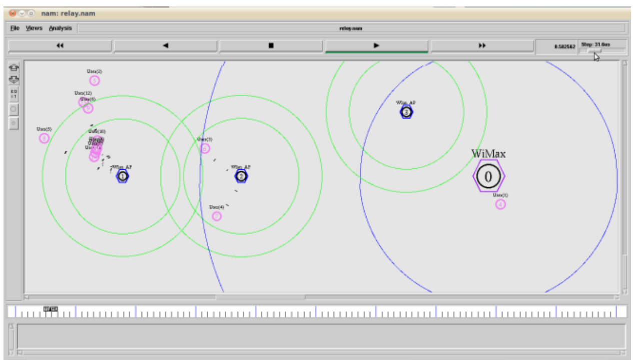
- In this module, when the primary user trying to hold the channel, that time SU searching the channel list.
- According to the channel availability, SU user changing the channel from one to another

Implementation Diagram




## IV. PERFORMANCE EVALUATION

For our analyzing purpose we are using the tools MATLAB and NS2. By using Matlab we are calculating the bandwidth and delay. And Ns2 is for showing the prototype model of VHO with enhancement such as ad-hoc property.

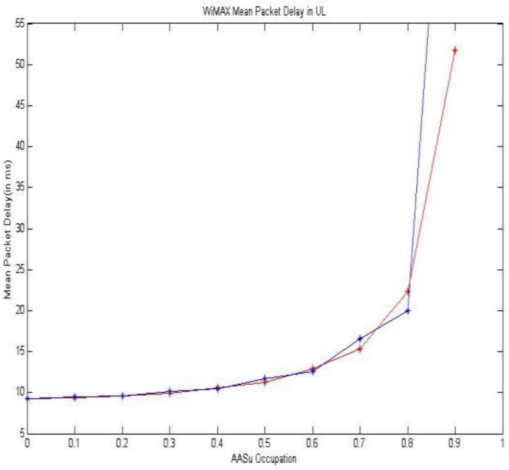



Nam output for cognitive model

Fig Nam output for cognitive model

In this Nam window output we are implementing model of WiMax and WLAN. In this model there are the 15 nodes (WiMax and Wlan and Mobile nodes) available. In this model, if mobile node is out of the range of Wlan and WiMax mean it can't get communication.

Mean Packet Delay in WiMax UL.

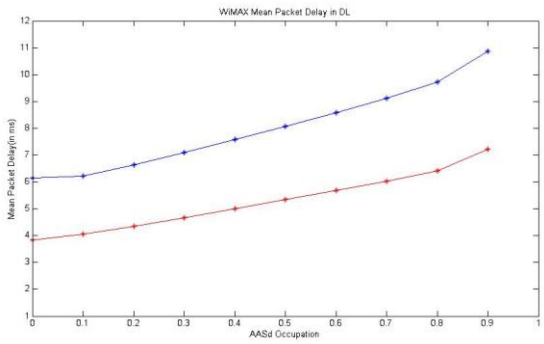



Mean Packet Delay in WiMax UL

We define the packet delay as the latency from the time that the packet arrives at the MAC layer buffer to the time that the packet is successfully transmitted

UL delay estimation the number of ways for stations to request bandwidth from BS. Where each station can obtain an opportunity to send Bandwidth Request (BWR) message to BS for it's newly arrived packets. From the analysis we can see that the estimated packet delay is determined by several parameters such as frame duration and the data rate. For the analysis, at the WiMax station we took a constant packet size of 500 bytes. For UL, the results were tested for different data rates and are seen in Fig

Mean Packet Delay in WiMax DL




Mean Packet Delay in WiMax DL

In the DL transmission, the BS has complete knowledge about the traffic. There is no need to send BWR messages. The mapping methods used in DL are quite different from those in UL. The standard requires all DL data bursts to be rectangular. According to the scanning order, current-mapping algorithms can be divided into two types. One type is scanning and assigning slots from symbol to sub channel and the other is from sub channel to symbol. It is supposed that one burst contains one packet. If the packet size L is larger than $\vartheta$ , which is number of bits transmitted by all sub channels in one slot duration, the packet will occupy the subsequent time slots and pack to a rectangular based on its length. From the graph the DL delay increases slowly with the increasing of $AAS_d$ occupation. This is indicates that the mapping delay increases with the utilization. In addition, we can see that the DL delay is much lower than the UL delay. That is caused by the fact that the station needs to spend an extra frame to send BWR message at UL. Moreover, the packet transmission extends from time domain to the frequency domain in UL, while the case in DL is converse.

## V. CONCLUSION

In this paper, our proposed framework can achieve fewer disruptions to primary transmissions by letting SUs proactively predict the future spectrum availability and perform spectrum handoffs before a PU occupies the current spectrum. And also we present a spectrum-aware mobility management scheme for CR cellular networks. Simulation results will show that the proposed method can achieve better performance than conventional handoff schemes in terms of both cell capacity as well as mobility support in communications.

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