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Simulation of Call Drop Minimization in Wireless Cellular Network using Cognitive Radio

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Abstract: The rapidly increasing number of consumers on the existing telecommunications network information is seen as the prime reasons for a great number of call drops. According to data accessible with Cellular Operators The Cellular Operators Association of India (COAI) estimates that the state's total mobile subscribers number in the millions. reached 82.19 million in December 2017. Previously, year, in February, the state had 70.32 million subscribers. The allotment of Call declines are occurring as a result of towers and a growing number of customers, especially during peak hours. In our proposed plan we aim to examine call dropping probability and handoff in next generation using cognitive radio. We will be using MATLAB as a platform for recreation. Analysis will be based on three probabilities like blocking probability, dropping probability and failure probability. Failure probability will decide the call drop which depends on blocking and dropping probabilities. After call drop it is required to do handoff to continue current call so we will be using reactive and proactive handoff algorithms.

I. INTRODUCTION

In our projected plan we aim to analyze call dropping probability and handoff in next generation using cognitive radio. We will be using MATLAB as a platform for simulation.

Analysis will be based on three probabilities like blocking probability, dropping probability and failure probability. Failure probability will decide the call drop which depends on blocking and dropping probabilities. After call drop it is necessary to do handoff to continue current call so we will be using reactive and proactive handoff algorithms. A call drop, In theory, it reflects the service provider's inability to manage an incoming or outgoing call after it has been properly developed. In India, call drops are a symptom of the country's telecommunications networks. The TRAI norm for call drops is 2%, which means that only two calls out of 100 can be dropped. The most critical aspect of a wireless cellular communication system is flexibility.

Continuous operation is normally achieved by supporting handoff (or handover) from one cell to another. Handoff is the process of changing the channel (frequency, time slot, spreading code, or a combination of these) associated with the current connection while a call is in progress. Another common cause is a drop in signal quality in the current channel or crossing a cell boundary.

The two most common forms of handoffs are strong and soft. "Breaking before making" and "making before breaking" are two of their catchphrases. A cognitive radio (CR) is a radio that can be dynamically programmed and designed to use the best wireless channels available in its region, avoiding interference and congestion. This form of radio scans the wireless spectrum for available channels and adjusts its transmission or reception parameters accordingly, allowing for more organised wireless communications in a single spectrum band. This is an example of complex spectrum management in action.

II. LITERATURE SURVEY

In cognitive radio networks, Chung-Wei Wang and colleagues investigated reactive spectrum handoff.

Li-Chun Wang's IEEE paper focuses on the modelling methodology and performance analysis for the reactive-decision spectrum handoff scheme and proactive-decision spectrum handoff. Reactive decision spectrum handoff can have a shorter handoff delay than proactive decision spectrum handoff since it can accurately find an idle channel by spectrum sensing. The reactive-decision spectrum handoff system, on the other hand, needs the detecting time to look for idle channels. It also requires handshaking time between the transmitter and receiver of a secondary communication to achieve harmony on the target channel. As a result, describing the impact of the sensing and handshaking times on the handoff delay is an important problem for the reactive-decision continuum handoff scheme. When sensing and handshaking periods are too long, the reactive-decision spectrum handoff is obviously worse than the proactive-decision spectrum handoff in terms of protracted data delivery time. With various traffic arrival rates and service time spreading, the aim of this paper is to investigate the effects of spectrum handoffs on channel usage and extended data transmission time of secondary users' connections.

A Real-Time Spectrum Handoff Algorithm for VoIP-based Cognitive Radio Networks: Design and Performance Analysis.

Tamal Chakraborty and Iti Saha Misra address this issue and propose a real-time spectrum handoff algorithm to ensure that VoIP calls meet the QoS requirements. The first phase employs a novel technique for making falling decisions based on adaptive tuning of timing parameters, while the second phase conducts well-organized channel selection in real-time without significant delay or call drop. The proposed algorithm, in general, takes advantage of the duration of an efficient VoIP call. There are two sections of the proposed algorithm. The first segment, VAST (VoIP-based Adaptive Sensing and Transmission), implements adaptive sensing and transmission durations for SUs, determining the conditions for dropping from the current channel as a result. After that, the second segment, ProReact (Proactive and Reactive Handoff), is completed, which performs efficient channel handoff to a new idle available channel without degrading the QoS limits (delay, loss) of VoIP calls. This paper focuses on simulating the real-world spectrum handoff method. When considering the time of spectrum sensing when a cognitive user has to turn to a different channel, the real mechanism is that the cognitive user must detect the channel he is using at the start of each time slot to ensure the channel is not being used by the primary user. As a result, the spectrum handoff mechanism must be investigated at each time period. Spectrum sensing, transmission, and handoff are the three parts of each time slot. We will investigate the relationship between the several time factors in spectrum handoff and get the numerical solution of average spectrum handoff time.

III. MOTIVATION

The rapidly growing number of consumers on the prevailing telecommunications network information is seen as the primary reasons for a large number of call drops. According to data available with Cellular Operators According to the Cellular Operators Association of India (COAI), the state's total number of mobile subscribers reached 82.19 million in December 2017. Earlier that year, in February, the state had 70.32 million subscribers. The allocation of towers, coupled with an increasing number of customers, is leading to call drops, especially during crowning hours.

Cognitive radio (CR) is a form of wireless communication in which a transceiver can detect which communication channels are in use and which are not, and turn to the unoccupied channels while avoiding the ones that are. This maximises the available radio-frequency (RF) spectrum while minimising interference for other users.

In its most basic form, CR is a hybrid technology that combines software defined radio (SDR) with spread spectrum communications.

A transceiver's ability to determine its topographical position, recognise and approve its user, encrypt or decrypt signals, sense neighbouring wireless devices in service, and change output power and modulation characteristics are all possible functions of cognitive radio.

Total cognitive radio and spectrum-sensing cognitive radio are the two major forms of cognitive radio. In complete cognitive radio, all parameters that a wireless node or network may be aware of are taken into account. The radio frequency spectrum is detected using cognitive radio with spectrum sensing.

A. Cognitive Radio's Functions

Following are the main functions of Cognitive Radio:

1) *Power Control:* Power management is used to optimise the capacity of secondary users while still putting some limitations in place to protect the primary users.
2) *Spectrum Sensing:* A cognitive radio can sense empty spectrum without causing any form of interfering to other users. There are three spectrum-sensing techniques:
   a) Transmitter Detection
   b) Energy Detection

B. Advantages of cognitive Radio

1) *Efficient Utilization of Spectrum:* The spectrum bands that are available can be used resourcefully as these cannot be increased. For utilizing the radio bands in a country, a license is required from the government. This is an expensive procedure. There are certain licensed spectrum bands that are underutilized and unutilized. Cognitive radio can utilize this spectrum and license holders are also not bothered. This unutilized spectrum is known as white space.
2) *More Space for new Technologies:* New technologies can be developed for these unexploited bands. Cost would also be minimal when this unutilized spectrum is used by the unlicensed user.

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3) *Ability to Utilize Multiple Channels:* In a customary wireless sensor network, a single channel is used for communication. In this, when an event is sensed, the sensor nodes generate packets. In a dense network, sensor nodes try to lodge the single communication channel at the same time. This increases the possibility of collisions and the communication quality is decreased. Moreover, there is more power consumption and packet delay. Cognitive radio gives the prospect to utilize multiple channels thereby reducing the chances of collision and also increases the communication quality.
4) *Energy Efficiency:* In traditional wireless sensor network, the power wastage is more due to increased packet retransmission due to packet loss. This energy depletion due to packet retransmission is overcome by cognitive radio.

C. Applications of CR

1) *Military and Security:* Cognitive Radio is used in various military and public services like chemical, biological and nuclear radiation detection, war surveillance etc. Customary wireless sensor networks face the problem of signal jam. But this problem is no longer exist if we use cognitive radio wireless sensor network. Cognitive Radio can handoff a wide range of frequencies. It is also useful when the applications need large bandwidth.
2) *Healthcare:* Cognitive Radio also find its applications in the healthcare. It find its use in wearable body wireless sensors. Using this, critical data and information from patients can be acquired by doctors sitting at a distant location. These wireless sensor nodes are also dependable.
3) *Home Appliances:* Wireless sensor network is used in certain indoor applications. But there are some challenges in those indoor applications. Cognitive Radio overcome these challenges. The examples of these applications are intelligent buildings, home monitoring system and personal entertainment.
4) *Real-Time Applications:* In multihop wireless sensor network, there are chances of link failure which can cause interruption in communication. Moreover, the nodes move to another channel if they find another channel idle. Cognitive Radio wireless sensor network increases the channel bandwidth due to which channel aggregation and use of multiple channels are possible

D. Working Principle

Cellular network has been defined based on primary user activity in area. Then unallocated spectral bands are assigned to Cognitive radio users governed by each cell configuration.

Calculations for performance: Performance of the system is evaluated in three QOS metrics; Blocking probability (Pb), dropping probability (Pd), failure probability (Pf)

1) *Calculation is based on state and transition probability.*

a) *Blocking Probability for PU:* Pb(i,PU), gives blocking probability for flow belonging to network 'i'.

A flow is blocked if it attains while cell is already using more resources than service threshold (i.e. $n(i) \geq Thi$)

$PB(i,CL)=\sum 1 s\in S \quad n(i) \geq Thi \times \pi s$

b) *Blocking Probability of CR:* In order a flow to be blocked two condition must be satisfies:

- Allresourcesmustbeoccupied($\sum n(j)$
  $= M$)
- ii. Network I already used all of its
  resources ($n(i) \geq Ki$)
  $Pb(I,CR)=\sum|\sum N n(j)=M\times 1 j=1|1 s\in S$
  $n(i)\geq KI \; x\pi s$

2) *DroppingProbability:* Classicflow 'f' isnever dropped. Therefore Pd(i,CR) is only Considered, droppingprobabilityofflow 'f' belongingtonetwork 'j'. For a flowtobe blocked following two conditions must be satisfied.

a) Allchannelsmustbeoccupied($\sum n(k)=M$)
b) Network 'i' usingmoreresources thanits physical processes ($n(i) \geq Ki$)

3) *Failure Probability:* CR user experiences more of dropping and reduced blocking probability compared to classic flow (Pd(i,PU) = 0). Therefore the general performance is compared by Pf, whee Pf is probability the arrived flow will not receive required service

$PF (i,CR) = PB (i,CR) + (1- PB(i,CR)) \times PD(i,CR)$

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The unlicensed devices which are using the license spectrum are observed with QOS. Assessments of QOS are made graphically and valuation of proposed system is done.

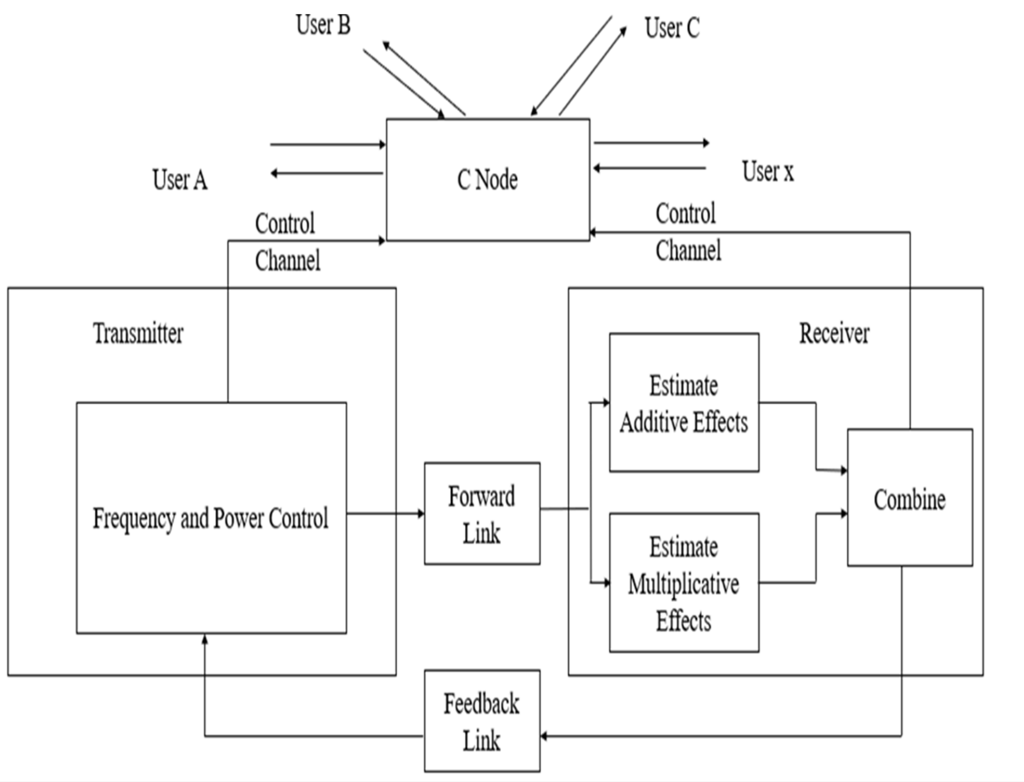
According to mobility events, each handoff scheme obliges different strategies as follows:

a) Proactive handoff: When CR user detects handoff events, they perform handoff procedures while preserving communications. After CR users make all decisions on the handoff, they cut off communication channels and switch to anew spectrum band or a new base station. Proactive handoff incidents include things like user versatility and cell overload. The majority of standard handoff schemes are constructive in nature.

b) Reactive handoff: The contact between CR users should be halted.

c) In the reactive handoff event, everything happens instantly. They make choices and do handoffs after that. As a result, unlike the constructive handoff strategy, this handoff has an additional handoff delay. In this case, the CR network could start the reactive handoff by immediately vacating the spectrum to avoid interference and then choosing a new available band.

IV. BLOCK DIAGRAM



The basic structural block diagram of our project is given in figure above. The tasks of the cognitive radio node include spectrum sensing at the receiver for the identification of spectrum holes, transmission of the sensing information to the transmitter side of the link via the feedback link and to the C-Node via the control channel and frequency and power control at the transmitter based on the feedback information from receiver and control information from the C-Node.

A. Spectrum sensing in each node and sensing information transmission to the common control channel.

B. Combining of sensing information in the C-Node and broadcasting to all CR terminals including the permission to the willing nodes to communicate.

C. Starting the transmission between the two terminals.

D. Periodic spectrum sensing is done every t seconds.

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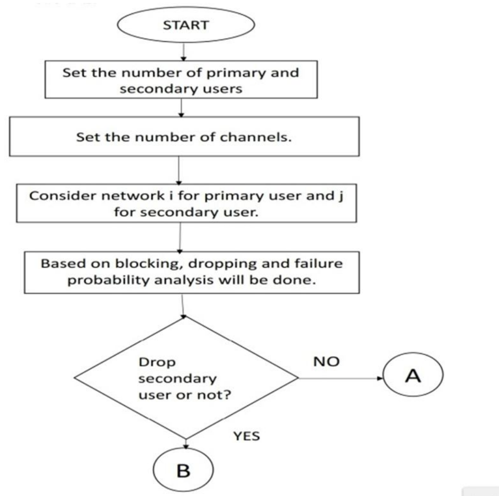
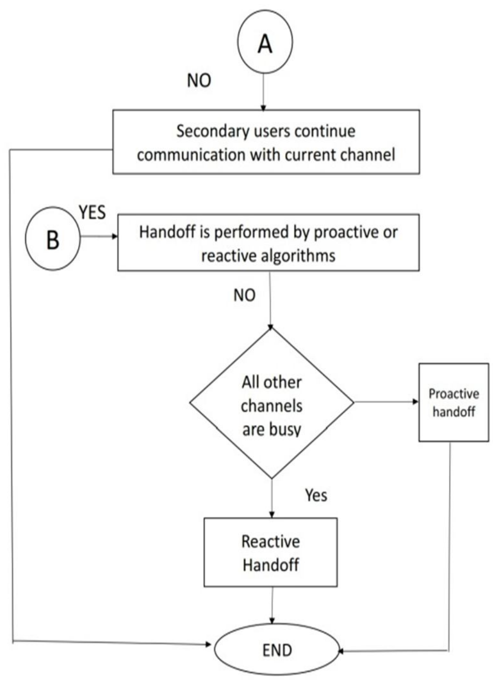
V. FLOW CHART



The C-Node starts by sending a beacon signal in a common control channel to inform other nodes the possibility to join the network. The locally sensed spectrum of nodes will be sent to a common control channel, combined in the C- Node, and the broadcasted to the CR terminals in the network

In essence, communication between two CR terminals can be divided into the following steps:



VI. CONCLUSIONS

The goal of this project is to reduce call drops which is a key issue due to increase in number of users. Also to provide unlicensed user a better opportunity to utilize a spectrum in the nonattendance of primary users that is licensed users. Considering spectrum flexibility as an integral part of Cognitive radio network, we also worked on handoff for well-organized communication without any delay. Cognitive radio is a new and stimulating technology that, among other applications, has the potential to unlock the spectrum necessary for the progress of next generation high data rate systems.

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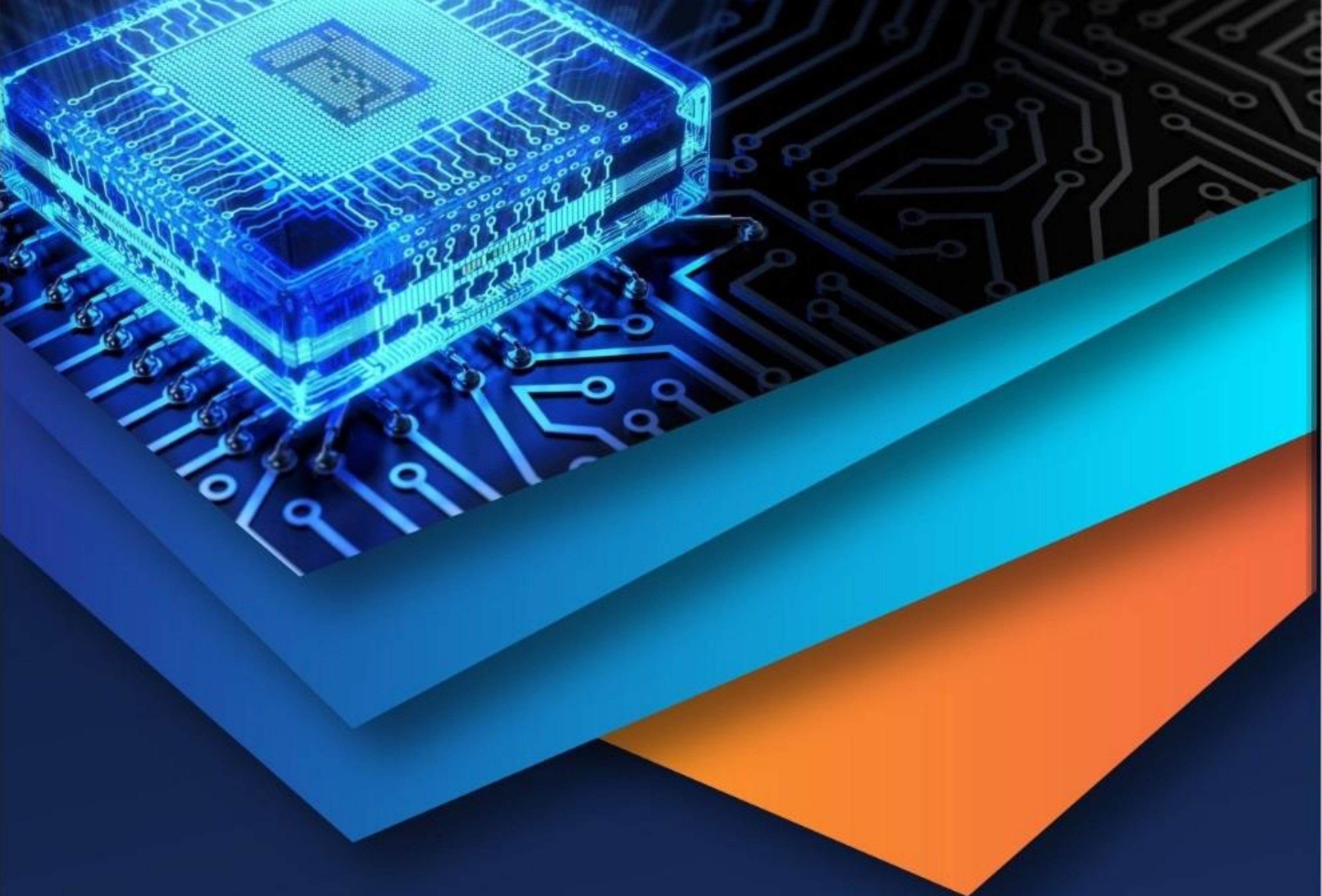

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