# Mobility Based Efficient Routing Protocol in Cognitive Radio Networks

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## ABSTRACT

*Cognitive Radio Networks, comprise of cognitive, spectrum adaptive devices which are capable of changing their parameters, taking into consideration the radio environment so as to utilize the spectrum efficiently as well as to provide dynamic utilization to the secondary users. For this, an effective route setup becomes a dire necessity so as to provide efficient transmission in a highly congested environment. This paper focuses on some of the obstructions during the establishment of route from sender to destination node. Also, with the nodes becoming mobile, routing becomes more complex. This paper proposes a routing protocol, that tries to curb the parameters related to routing while considering the mobility of nodes into account.*

**Keyword: -** ***Cognitive Radio Networks; routing environment; radio spectrum; location-aided routing; challenges in routing***

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## 1. INTRODUCTION

Current wireless networks are regulated by governmental agencies mainly according to a fixed spectrum assignment policy. The usage of licensed spectrum is quite uneven and depends heavily on the specific wireless technologies. Recent studies by the Federal Communications Commission (FCC) highlight that many spectrum bands allocated through static assignment policies are used only in bounded geographical areas or over limited periods of time, and that the average utilization of such bands varies between 15% and 85%[1].

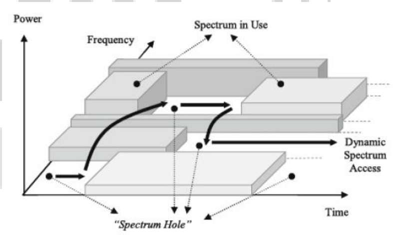



**Fig.1: Spectrum-Hole Concept[1]**

The potentials of multi-hop CRNs needs to be realized which can open up new and unexplored service possibilities enabling a wide range of communication applications. The cognitive concept can be applied to different scenarios of multihop wireless networks including Cognitive Wireless Mesh Networks featuring a semi-static network infrastructure and Cognitive radio Ad Hoc Networks (CRAHNs) characterized by a completely self-configuring architecture, composed of CR users which communicate with each other in a peer to peer fashion through ad hoc connections.

In this paper, we focus on the issues related to the design and maintenance of routes in multi-hop CRNs. The purpose describes the most common approaches to routing in CRNs, clearly highlighting their design and their strengths/drawbacks.

## 2. ROUTING CHALLENGES IN MULTIHOP CRNs

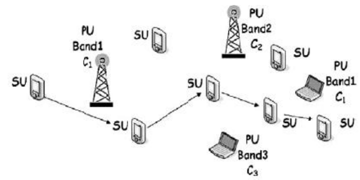



**Fig.2: Information Routing in Multi-hop CRNs[8]**

The network model [9] taken for reference shown in fig.2 describes secondary devices sharing different spectrum bands along with primary users. The PUs are assumed to be stationary while the SUs are considered to be mobile. Here, the problem of routing in multi-hop CRNs lays emphasis on the creation and the maintenance of wireless multi-hop paths among SUs by deciding both the relay nodes and the spectrum to be used on each link of the path. Such problem exhibits similarities with routing in multi-channel, multi-hop ad hoc networks and mesh networks, but with the additional challenge of having to deal with the simultaneous transmissions of the PUs which dynamically change the SOPs availability. The main challenges for routing information in CRNs include:

### 2.1 SPECTRUM AWARENESS:

Designing solutions for efficient routing in multi-hop Cognitive Radio Networks requires a tight coupling between the routing module(s) and the spectrum management functionalities such that the routing module(s) can remain continuously aware of the surrounding physical environment to take more accurate decisions with regards to spectrum management.

### 2.2 SETTING UP OF QUALITY ROUTES:

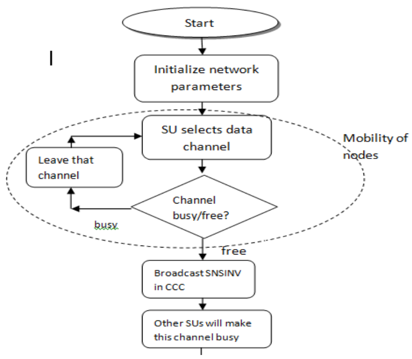
In dynamically varying environment, the route setup needs to be redefined in CR scenario. The topology of multi-hop CRNs is highly influenced by PUs' behavior, and classical ways of measuring/ assessing the quality of end-to-end routes (nominal bandwidth, throughput, delay, energy efficiency and fairness) requires to be coupled with novel measures on path stability, spectrum availability/PU presence.

### 2.3. MAINTAINING/REPAIRING ROUTES:

The sudden appearance of a PU in a given location may render a given channel unusable in a given area, thus resulting in unpredictable route failures. This require frequent path rerouting either in terms of nodes or used channels.

## 3. LAMAR Routing Protocol

A dedicated channel called common control channel (CCC) is used by SUs to exchange control information between relay neighbors. At each hop, the sender first senses for a spectrum access opportunity and select a relay node if the channel is found idle i.e. if no primary user activity is detected in the sensed channel. The occupation time of PUs in each data channel is modeled as an independent and identically distributed alternating ON (PU is active) and OFF (PU is inactive) process. SUs monitor the channel statistics, i.e., ON or OFF, and obtain the channel usage information through periodic sensing operations. Here, mobility of the nodes will be taken into account. Then it will start for relay selection process. The process is shown as below.



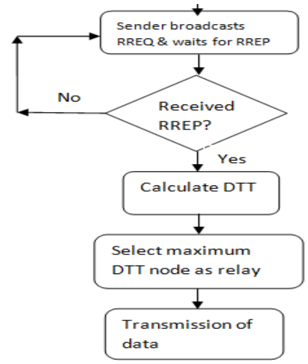
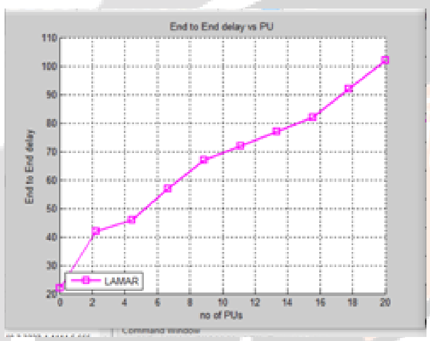




**Fig.3: Channel Selection along with mobility** **Fig.4: Relay Selection Process**

## 4. Results



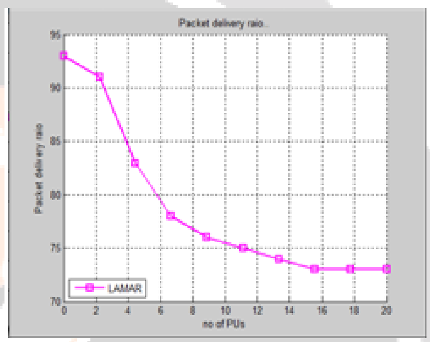
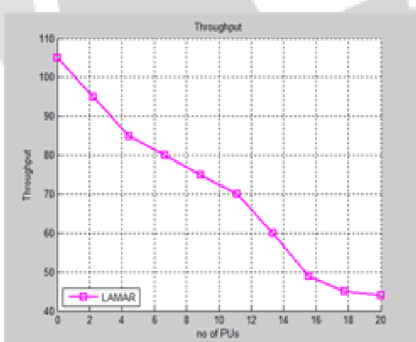




**Fig.5: End to End Delay** **Fig.6: Packet Delivery Ratio**



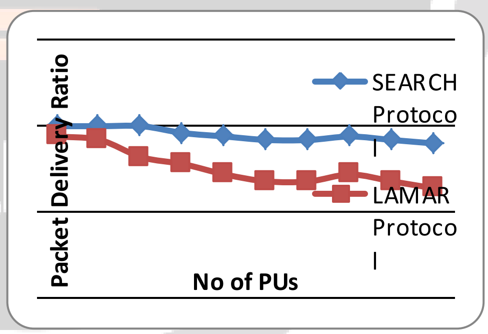




**Fig.7: Throughput** **Fig.8: Packet Delivery Ratio**

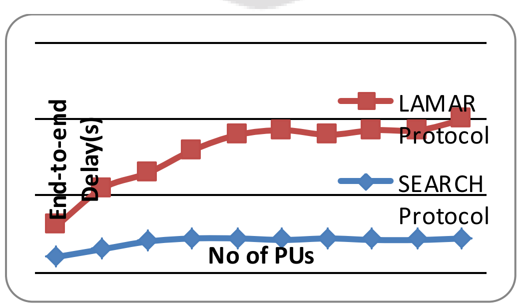



**Fig.9: End-to-end Delay**

The end-to-end delay, packet delivery ratio and throughput of LAMAR protocol is shown by figure 5, 6 &7. The comparison of SEARCH protocol and LAMAR protocol in terms of Packet Delivery ratio and end-to-end delay is shown in figure 8 & 9. Here, the performance of LAMAR is somewhat similar to SEARCH because of the introduced mobility and the noise introduced in channel.

## 6. CONCLUSION

In this paper, CR networks are reviewed and the problems associated with the routing of networks. The proposed protocol make use of location information to design the routing parameters of the network taking the mobility of the node into account and tries to curb the end-to-end delay during routing. Also, the proposed protocol aims to increase the packet delivery ratio and throughput of the communication system.

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