A MULTIPATH ROUTING PROTOCOL FOR COGNITIVE RADIO AD HOC NETWORKS

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ABSTRACT

Multihop routing is the advanced technology in wireless Networks. Multipath routing protocols for MANET are deemed superior over conventional single-path routing as the former to reduce end to end delay, increase consistency and provide toughness. Quality of Service (QoS) is an essential feature of networks. One of the main problems in Ad-hoc networking is the delivery of data packets to the nodes where the topology is not predetermined. Hence, implemented route stability based multipath QoS (AOMDV) protocol to support higher throughput and reduced delay, in real time application networks. The simulation result outperforms AODV Protocol with a throughput of 87.5% and delay of about 2.5% for 20 nodes.

Keywords: Multihop, MANET, QoS, Throughput

I. INTRODUCTION

Cognitive Radio (CR) technology is to enhance the spectrum utilization by enabling unlicensed users to exploit the spectrum in an opportunistic manner. Cognitive Radio is a transceiver which automatically detects the available channels in wireless spectrum. It is a key technology to realize Dynamic Spectrum Access (DSA) that enables an unlicensed user to adaptively adjust its operating parameters and exploit the spectrum which is unused by licensed users in an opportunistic manner. A cognitive network is an opportunistic network. Spectrum opportunity deals with the usage of an available (free) channel that is a part of the spectrum which is not currently used by primary users.

A cognitive radio is a SDR (Software Defined Radio) with a cognitive engine brain. Cognitive radio is considered as a goal towards which a software-defined radio platform should evolve a fully reconfigurable wireless transceiver which automatically adapts its communication parameters to network and user demands. Cellular network bands are overloaded in most parts of the world, but other frequency bands (such as military, amateur radio and paging frequencies) are insufficiently utilized. Moreover, fixed spectrum allocation prevents rarely used frequencies (those assigned to specific services) from life form used, even while any unlicensed users would not cause noticeable interference to the assigned service. Thus it allows unlicensed users in licensed bands if unlicensed users would not root any intrusion to licensed users. These initiatives have alert cognitive-radio research on dynamic spectrum access.

Cognitive radio and ad-hoc networks implement proactive spectrum handoff protocol. The first forwarding system before proactive spectrum handoff protocol was reactive spectrum handoff protocol. In reactive spectrum handoff protocol unlicensed users are temporary visitors to the licensed spectrum; they are required to vacate the spectrum when a licensed user reclaims it. When the temporary visitors fail to vacate the spectrum collision might occur which leads to low throughput. But however reactive spectrum handoff protocol has a fundamental limitation that is limited by allocating a spectrum channel to the secondary user which is not used by the secondary user. The collisions and low throughput are the most common case of the failures in the reactive spectrum handoff protocol, which is overcome by the proactive spectrum handoff protocol. Thus, it avoids collisions and increases the throughput.

II. PROACTIVE SPECTRUM HANDOFF APPROACH

2.1 Introduction

Cognitive radio (CR) can improve spectrum efficiency through intelligent spectrum management technologies by allowing secondary users to temporarily access primary users' unutilized licensed spectrum. In order to enhance spectrum management, CR systems require many capabilities such as spectrum mobility (or called spectrum handoff). Spectrum handoff occurs when the high-priority primary users appear at its licensed band occupied by the secondary users. Spectrum handoff procedures aim to help the secondary users to vacate the occupied licensed spectrum and find suitable target channel to resume the unfinished transmission .In general, according to the target channel decision methods, spectrum handoff can be categorized into two mechanisms. They are proactive-decision spectrum handoff and reactive spectrum handoff. Proactive decision spectrum handoff which makes the target channels for spectrum handoff ready before data transmission according to the long-term observation. Reactive decision spectrum handoff determines the target channel according to the results from on-demand wideband sensing. Compared to the reactive-decision spectrum handoff, the proactive-decision spectrum handoff may be able to reduce handoff delay because the time-consuming wideband sensing is not required. Furthermore, it is easier to let both transmitter and receiver have a consensus on their target channel for the proactive-decision spectrum handoff than for the reactive decision spectrum handoff. Nevertheless, when the spectrum handoff process is initiated, the proactive-decision spectrum handoff needs to resolve the issue that the pre-selected target channel may no longer be available. Hence, one challenge for the proactive-decision handoff is to determine the optimal target channel sequences to minimize total service time.

2.2 Objective

The main aim of this project is to make the unlicensed users to use the licensed spectrum in an efficient way and to vacate a channel before a licensed user utilizes it, to avoid unwanted interference & to achieve higher packet delivery rate and there is proven increase in the throughput.

2.3 Spectrum Handoff in Cognitive Radio Network

Related work on spectrum handoffs in CR networks falls into two categories based on the moment when SUs carry out spectrum handoffs. One approach is that SUs perform spectrum switching and Radio Frequency (RF) front-end reconfiguration after detecting a PU, namely the reactive approach. Although the concept of this approach is intuitive, there is a non-negligible sensing and reconfiguration delay which causes unavoidable disruptions to both the PU and the SU transmissions.

Another approach is that SUs predict the future channel availability status and perform spectrum switching and RF reconfiguration before a PU occupies the channel based on observed channel usage statistics, namely the proactive approach. This approach can dramatically reduce the collisions between SUs and PUs by letting SUs vacate channels before a PU reclaims the channel. In the proactive approach, a predictive model for dynamic spectrum access based on the past channel usage history is proposed in. A cyclostationary detection and Hidden Markov Models for predicting the channel idle times are proposed in a binary time series for the spectrum occupancy characterization and prediction is proposed. In a novel spectrum handoff scheme called voluntary spectrum handoff is proposed to minimize SU disruption periods during spectrum handoff .The error prediction of the channel usage is considered in designing an intelligent dynamic spectrum access mechanism. The experimental cognitive radio test bed is presented. It uses sensing and channel usage prediction to exploit temporal white space between primary WLAN transmissions.

2.4 Channel Selection in CR Networks

Even though the channel allocation issue has been well studied in traditional wireless networks (e.g., cellular networks and Wireless Local Area Networks (WLANs)), channel allocation in CR networks, especially in a spectrum handoff scenario, and still lacks sufficient research. When SUs perform spectrum handoffs, a well-designed channel selection method is required to provide fairness to all SUs as well as to avoid multiple SUs to select the same channel at the same time. Currently, the channel selection issue in a multi-user CR network is investigated mainly using game theoretic approaches. Furthermore, most of the prior work on channel allocation in spectrum handoffs only considers a two secondary user scenario, where a SU greedily selects the channel which either results in the minimum service time or has the highest probability of being idle. Only one pair of SUs is considered and the channel selection issue is ignored. However, if multiple SUs perform spectrum handoffs at the same time, these channel selection methods will cause definite collisions among SUs. Hence, the channel selection method aiming to prevent collisions among SUs in a multisecondary- user spectrum handoff scenario is ignored in the prior work.

2.5 Analytical Model for Spectrum Handoff in CR Networks

An analytical model is of great importance for performance analysis because it can provide useful insights into the operation of spectrum handoffs. However, there have been limited studies on the performance analysis of spectrum handoffs in CR networks using analytical models. The performance analysis of all prior works on spectrum handoff is simulation based with the exception of that a pre emptive resume priority queuing model is proposed to analyze the total service time of SU communications for proactive and reactive-decision spectrum handoffs. However, only one pair of SUs is considered in a network, while the interference and interactions among SUs are ignored, which greatly affect the performance of the network. In all the above proposals, a common and severe limitation is that the authors assume that the detection of PUs is perfect *i.e.*, a SU transmitting pair can immediately perform channel switching if a PU is detected to appear on the current channel, thus the overlapping of SU and PU transmissions is negligible. However, since the power of a transmitted signal is much higher than the power of the received signal in wireless medium due to path loss, instantaneous collision detection is not possible for wireless communications. Thus, even if only a portion of a packet collides with another transmission, the whole packet is wasted and needs to be retransmitted. Without considering the retransmission, the performance conclusion may be inaccurate, especially in wireless communications.

2.6 The Proposed Distributed Channel Selection Scheme

The performance of the proposed channel selection scheme is investigated and compared it with the following three different channel selection methods under the proposed proactive spectrum handoff scenario using the single rendezvous coordination scheme.

Random channel selection: A SU randomly chooses a channel from its predicted available channels.

***Greedy channel selection*:** In this method, only one pair of SUs is considered in the network. The SUs can obtain all the channel usage information and predict the service time on each channel. Thus, when a spectrum handoff occurs, a SU selects a pre-determined channel that leads to the minimum service time.

Local bargaining: In this method, SUs form a local group to achieve a collision free channel assignment. To make an agreement among SUs, a four-way handshake is needed between the neighbours *i.e.*, request, acknowledgment, action, acknowledgment. Since one of the SUs is the initiating node which serves as a group header, the total number of control messages exchanged is 2*N*LB, where *N*LB is the number of SUs needed to perform spectrum handoffs. Since for channel selection schemes, reducing the number of collisions among SUs is the primary goal, consider the SU throughput, average SU service time, collisions among SUs, and average spectrum handoff delay as the performance metrics.

2.7 Advantage

1) A distributed channel selection scheme to eliminate collisions among unlicensed users in a multiuser spectrum handoff so that, there is no interference or collisions.
2) As there are no collisions the proactive spectrum can achieve high throughput value and higher packet delivery.
3) Due the spectrum handoff, packet loss is greatly reduced.
4) Compared to reactive spectrum the quality of service is improved

III. RESULTS & DISCUSSION

Implementation is done by using Ns-2 software.

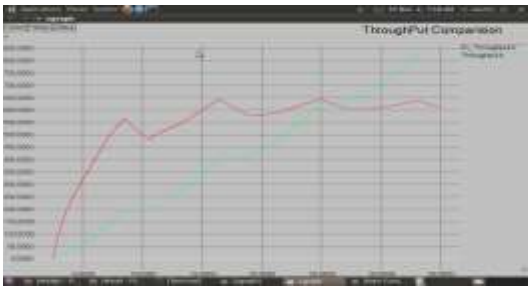

Fig 3.1 Graph Representing Throughput in Wireless Networks

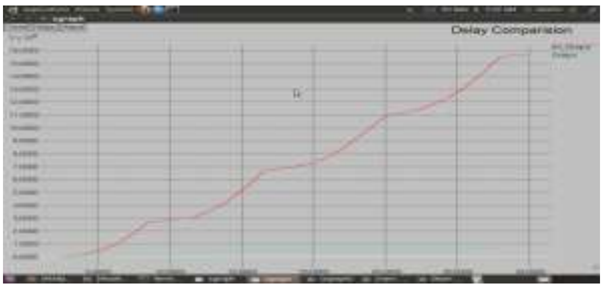

Fig 3.2 Graph Representing Delay in Wireless Networks

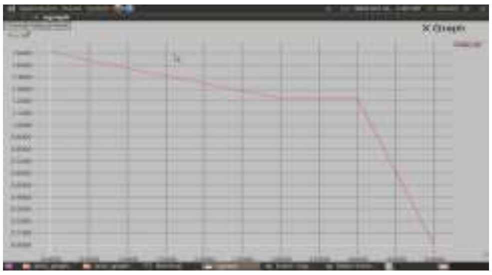

Fig 3.3 Graph representing delay in CR Technology

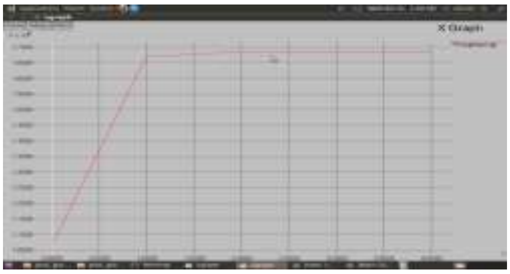

Fig 3.4 Graph representing Throughput in CR Technology

DISCUSSION

Fig 3.1, 3.2 shows the performance of the existing work in terms of congestion detection & avoidance. In Fig 3.1 the existing work shows that, as the transmission rate increases throughput also initially increases and then drops due to collision in the network, whereas in congestion detection & avoidance, it initially increases and then remains constant as it avoids collision .Thus it achieves higher throughput of about 78.6% .In Fig 3.2 the existing work shows that as the number of user increases, the delay also increases and it reaches infinity, whereas in congestion detection & avoidance it is noted that delay is slightly increased and remains constant wherever the probability of maximum collision is more .Thus delay is decreased by 5.41%. Fig 3.3 and 3.4 shows the performance of different number of secondary users. In Fig 3.3 CR technology shows that as the number of SUs increases the throughput also increases and then remains constant because of the maximum utilization of unused spectrum. It achieves a throughput of about 85%. In Fig 3.4 it shows as the number of users increases delay is reduced to about 3.5%. From Table 3.1 The result analysis shows that comparison between wireless network and CR technology .There are various drawbacks in the wireless networks which includes low throughput and more delay. On analyzing the cognitive radio technology, unused spectrum utilization is more, collision avoidance and interference is less. Thus high throughput and packet delivery is achieved.

IV CONCLUSION

In cognitive radio technology interference and collision avoidance is explained. Proactive spectrum handoff protocol triggers the unlicensed users to vacate the channel before the licensed user utilizes it. Cognitive Radio can achieve higher packet delivery and maximum throughput.

V FUTURE WORK

Channel sensing in Cognitive Radio can be carried out by using waveform based sensing.

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