A Novel Channel Assignment Protocol for Uncoordinated WLANS

Achal Badgujar, Swati Nikam

Abstract— Nowadays due to easily available hardware and availability of unlicensed frequency spectrum the use of WLANS has increased tremendously. Such WLANS are set up by untrained system administrators with no topology planning. The Access Points are also placed haphazardly. The performance of such Uncoordinated WLANs is greatly affected due to availability of limited number of non-overlapping channels. The cognitive radio provides the clients to make use of free channels from licensed spectrum when they are not in use by primary users. Thus in cognitive environment more channels are available to the clients. This paper describes a novel channel assignment scheme for cognitive radios.

Index Terms— Uncoordinated WLANS, Channel Assignment, Cognitive Radio, Throughput.

I. INTRODUCTION

The availability of unlicensed spectrum and easily available hardware has made WIFI an household name today. These WIFIs are set up by untrained system administrators .There is no topology planning and Access Points (AP)are placed haphazardly. Due to this it happens that in a certain zone the density of AP is more than other. The unlicensed spectrum ie the 2.4GHZ band has 14 allowable channels(in USA) but out of these only three(1,6,11) are non-overlapping as shown in Figure 1.If the APs in nearby vicinity use a common frequency channel they face a strong co-channel interference .This greatly reduces the throughput and affect network performance. But since these APs are mostly configured to use only three common channels, this problem is highly prevalent nowadays. The solution to this problem is Cognitive Radio.
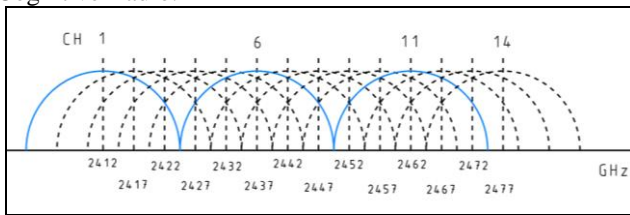

Figure 1   2.4 GHz unlicensed spectrum

II. COGNITIVE RADIO

Cognitive Radio is nothing but a software radio that is intelligently able to sense its surrounding environment and make required adaptations. The idea was proposed when it was realised that it is not that every time the channels on licensed spectrum such as TV channels ae utilised. So when the TV channels are free, the Cognitive Radio can sense the free channels and these free channels can be used by APs using unlicensed spectrum. This would improve throughput greatly.

III. RELATED WORK

A lot of work has been done with the objective to reduce interference and increase the system throughput.

There are many centralized algorithms that assume network administrators conduct site surveys and do propagation modeling before network deployment [1], [2], [3], [4],[5]. However, in uncoordinated WLANs, we cannot rely on administrators to configure the network. Mishra et al. gave a dynamic channel assignment algorithm called CFAssign-RaC to achieve load-balancing based on a "conflict set colouring" formulation. Ahmed et al. propose an algorithm using successive refinement to solve a joint channel assignment and power control problem [6]. Kauffmann et al. propose a measurement based self-organization approach for channel assignment.and the changing traffic patterns to make channel assignment decisions[7]. Being traffic-aware, these approaches are able to reduce interference dramatically.

However, they are still centralized algorithms and CACAO[8] is able to be traffic aware in a distributed manner.Mishra et al. propose a distributed algorithm called MAXChop[9], which addresses channel assignment problem based on standard graph colouring formulation and calculates a channel hopping sequence at each AP to reduce Interference. However, such hopping sequence needs to be periodically communicated among APs, and frequent hopping introduces much overhead into the system. Moreover, the MAXChop algorithm has not considered the changing traffic pattern. As a result, it is possible that heavily loaded adjacent APs are assigned to the same channel at some hopping slots, leading to high interference. Xiao Nan Yue, Chi-fai Michael Wng proposed a novel distributed channel assignment scheme termed as CACAO for uncoordinated WLANs, it leads to better interference mitigation and better performance but it fails to give a good throughput because it uses the limited that is three overlapping channels.

In this paper, we compare these two channel schemes LCCS [10] which is a very widely used channel assignment scheme with our algorithm based on two parameters (throughput, packet delivery ratio)

IV. CHANNEL ASSIGNMENT PROTOCOL

The channel assignment protocol has following routines

A. Initial Assignment

The APs are initially assigned to one of available channels

B. Interference calculation

For interference calculation on each channel we used a routing metric call ETT (Expected Transmission Time).This metric gives us transmission time on each channel required by each client. Then based on calculation each client chooses the channel with minimum ETT. The channel chosen by each client will obviously be the one with minimum interference.

C. Switch

Each client every time will then switch to channel that is chosen after the previous calculation

V. ROUTING PROTOCOL IN OUR ALGORITHM

The routing mechanism used currently in our protocol is an AODV protocol, modified for multichannel operation in cognitive environment.. The modifications to the original AODV protocol include incorporating a mechanism for finding a channel diverse route, avoiding interference, and reducing the overall expected trans-mission time in addition to reducing the number of hops. To utilize the benefit of using multiple channels, it is necessary to make sure that a flow experiences minimum intra-flow interference (interference due to transmissions of the same flow on adjacent hops). This will require that the route taken by the flows is such that the adjacent hops are on different channels as much as possible. Furthermore, it is useful to avoid routing multiple flows through a single node, as this may result in the node requiring switching its transmission channel frequently for routing the flows, which may possibly be targeted at neighbors on different channels. These requirements are incorporated in the form of a routing metric, called the ETT.

L_j is the total ETT cost for all links using channel j on the route, and is given by

$$L_j = \sum ETT_i \qquad (1)$$

The ETT of a link is given by $ETT = ETX * (S/ B)$, where ETX is the expected number of transmission attempts (including re-transmissions) required to transmit a packet, S is the average packet size and B is the data rate of the link. The expected number of transmissions is estimated based on the loss in the link.

The multichannel protocol also incorporates a few other modifications .For instance, when a routing entry is created for a node, it is also necessary now to indicate the channel and the actual interface to use for reaching the next hop. The multichannel routing protocol incorporates the appropriate mechanism for creating the route entries.The multichannel Routing protocol incorporates a procedure for refreshing route, by which a source node initiates a route discovery periodically for learning routes with better costs or for updating the costs of the current route.

VI. RESULTS

Our simulation settting are as shown in table below

Medium Access Protocol	IEEE802.11
Radio Propagation Model	shadowing
Link Data rate	11Mbps
RTS/CTS	ON
Bounding box size	500m by 500m
Packet size	512 bytes

Routing Protocol	COGRADIO
Simulation Trials	5
Number of Channels(variable)	4

Table I Simulation Parameters

To provide the cognitive environment we have used the cognitive radio cognitive network simulator.

We have compared our results with tradtional protocol LCCS The comparison is on basis of Throughput and packet delivery ratio as shown in Figure 2 and Figure 3 respectively
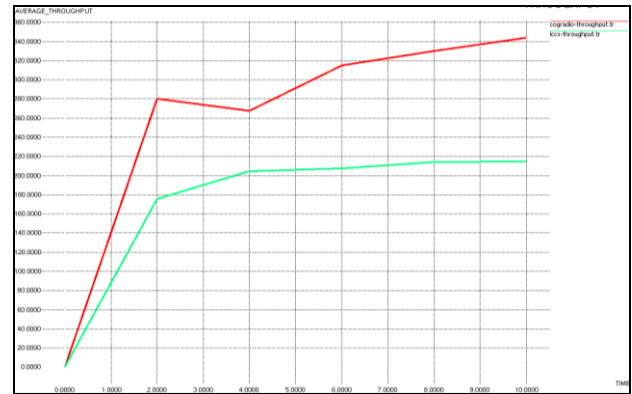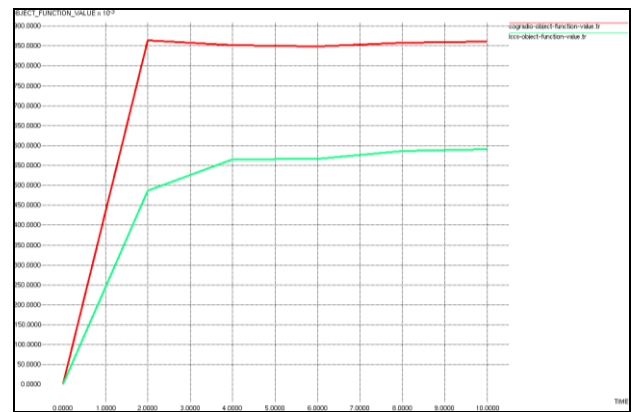

Figure 2 **Throughput**

Figure 3 **Packet Delivery ratios**

VII. CONCLUSION

Our results clearly show that a great increase in throughput can be achieved by using cognitive radio instead of traditional radio. More and More research is going in this area .Our work is a channel assignment algorithm for cognitive radio which greatly improves throughput and hence network performance.

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