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Appropriate Dynamic Channel Allocation based on Priority Scheduling in heterogeneous Cognitive Radio Networks

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***Abstract*—Cognitive Radio (CR) is an emerging wireless communication technology that offers a great solution to scarcity of radio spectrum. Cognitive Radio Network (CRN) is an intellectual wireless communication scheme that conscious of its environment. Here, problem is sensing of spectrum by heterogeneous nodes with different computing power variation, and sensing rang. There are two tasks in this networks are primary channel sensing and selection of appropriate unused channel for communication by secondary users. In this article we present an idea to formulate a contention based channel selection algorithm using priority queue scheduling algorithm. In CRN secondary users play the important role of channel selection. This algorithm will avoid collision during data transmission between heterogeneous nodes and improve the entire network throughput.**

Keywords-Cognitive Radio; Dynamic Scheduling; Priority Queue; Heterogenetive Services

I. INTRODUCTION

In recent years, the cognitive radio network is an emerging technology. It offers a great solution and improve the effective spectrum utilization by secondary users when primary users in idle [1]. Primary Users (PU) (licensed user) used licensed frequency spectrum for special applications. Generally, Secondary Users (SU) (unlicensed users) uses more spectrum utilization compared to PU [2]. CR is an intelligent system which should sense its environment and adjust spectrum. And also makes an intelligent communication system like transmitting and receiving signals. CR identified that which channel is being busy or not and transferred to unused channels. These methods reduced interference with other users and make it best use of offered radio frequency spectrum [3-15]. The proposed system improves the resource allocation based on priority scheduling method. Here channel quality indicator (CQI) function is used to determine the packets priority with queue delay. The incoming streams of each packets priority and channel gain are estimated by CQI. The calculative values of each stream can be sorted in the descending order. The highest priority stream allocated to the SU. In simulation result the proposed system provides significant improvement of the throughput with minimum delay Rest of this article we present literature survey in section II, problem identification and solution in section III, the proposed solution in section IV, simulation result in section V and conclusion of this article in section VI.

II. LITERATURE SURVEY

Indika A. M. Balapuwaduge, Lei Jiao, Vicent Pla [4] have proposed a queue-based channel assembling strategy for heterogeneous channel CRNs and analytical structure for performance evaluation of such networks. They achieved significantly reduces forced terminations of ESU services, it is recommended if PUs are more active in a CRN.

Minal S. Moon et al [5] have proposed appropriate channel selection for data communication using energy detection sensing technology and introduced a structure called preferable channel list, PCL has been used for selection of channel anywhere, and receiver is being playing the dominating role. The proposed technology provided the delay is less however the throughput of the system is good.

Dibakar Das et al [6] have proposed two caching and scheduling strategies using Lyapunov drift techniques between primary and secondary request generation rates which can be supported to increases from the case without cooperation. Fixed Primary Caching Policy (FPCP) algorithm increases the set of request generation rates that can be maintained. Additionally they also proposed variable primary caching policy (VPCP) algorithm maintains higher priority files. They have been conducted widespread simulations to compare the performance of both algorithms against that of an optimal nonco-operative algorithm. Finally, they could have extended the analysis to a network with multiple channels.

Navdeep Kaur et al [7] have proposed an efficient resource allocation technique which uses very reliable nodes for data transmission. The resources are allocates only after ensuring that the nodes satisfied constraints. They achieved a good network.

III. Problem Identification

From this literature survey we can be conclude that there is no dynamic resource allocation based priority scheduling in CRN. Consider the network with heterogeneous services can be challenging in allocating the resources and assign the channel to each node in the given network. The secondary users with different rate requirements are considered ignoring the delay requirements. Moreover, while estimating the channel state for capable communication, the channel quality indicator (CQI) has to be considered

In this proposal we can propose to develop a dynamic resource allocation and priority-based scheduling for heterogeneous services in cognitive radio network (CRN). CRN network consists of primary and secondary users with heterogeneous network require different service requirements. The secondary network consists of base station and may nodes. The base station in secondary network is the responsibility of resource allocation to various secondary users (SUs). Here a channel quality indicator (CQI) is used as a utility function for each channel. The CQI is used to measure signal-to-interference-plus-noise ratio (SINR). For every arriving stream, the priority of packets is specified by depending on the service type and queuing delays. Then an objective function is estimated for each stream by multiplying the priority with channel gain. Then the streams should be sorted in the descending order of this objective values, then allocated to the respective type of SU [9].

IV. Proposed Solution

A. Spectrum sensing

The radio spectrum sensing is the most important phenomenon that enables the cognitive radio to have knowledge of spectrum usage and makes to detect the spectrum opportunity. We can implement cognitive radio system when the source node needs to communicate with destination node, both the nodes can be responsible for spectrum sensing. In-band sensing is done during data transmission to detect the presence of primary user whereas out-band sensing is done to search novel spectrum opportunity[5].

B. Channel Selection

Depending on the result of channel sensing, the channel allocation system gives available channels to competing users for improving spectrum utility. In the proposed algorithm the channel selection is done according to priority queue scheduling methodology The utilization of the channel in the transmission range of the node is maintained in based on their arrival stream of packets are determined by priority which is maintained by the queuing delay[5].

C. Channel Quality Indicator (CQI)

The CQI is used to estimate a counting value for each available spectrum opportunity. Such counting value quantifies the utility that each channel offers to the CR in terms of average information transfer capacity from its network peers to it, and takes into account the selections of neighbouring CRs, noise, and interference [9].

D. System Model

The cognitive radio communication system consists of primary user and secondary user. The secondary users or cognitive users have a low spectrum access authority. Secondary users should continuously sense the atmosphere and should be aware of any changes in their wireless network and make adjustments to communication changes consequently without causing harmful interference to the primary users. The main aim of the spectrum sensing is to find available free spectrum resources (un-accessed channels), estimate the channel quality, transmit the data packets and design self-adaptive transmitting waveform which fit spectrum characteristics based on communication requirements. The secondary users should access the idle channel optimally when the primary users are not accessed channels. And periodically check the capability of the PU such that the Cognitive users' handovers the channel to the PU as soon as a PU is detected. Hence, the SU doesn't interfere with the PU and only access the idle channel when the PU is not accessing the given channel. PUs operations are given more priority as during the channel utilization.

In figure 1, shows primary and secondary networks. Primary network consists of primary users and primary base station. Secondary networks consist of secondary users and secondary base station. Every primary user in primary network, accessed channels and secondary users are waiting for getting channel from primary network.

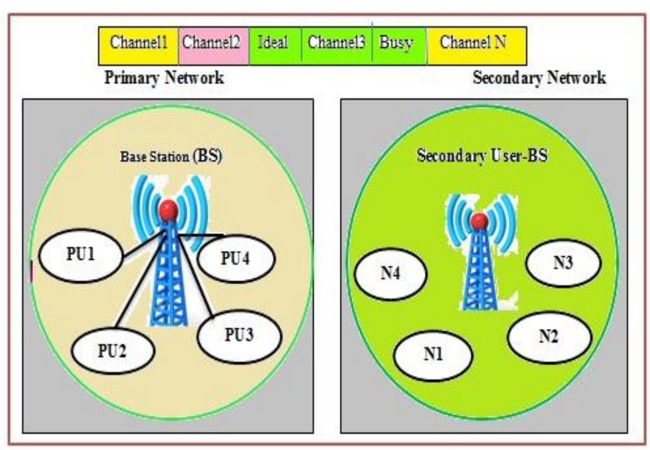

Figure 1. Heterogeneous CRN with multiple PU and SU

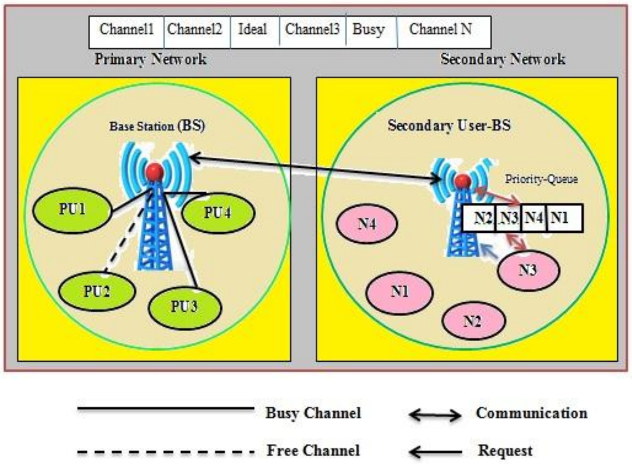

Figure 2. SU accessing the idle channel of PU through SU-BS

At secondary user base station, the existence of the primary user is estimated periodically by Channel Quality Indicator (CQI). CQI also quantifies utility, which each channel estimates to the CR in terms of average information transfer capacity and the interference. If the CQI value decreases beyond a threshold value, it indicates the presence of PU and hence the SU hands over the sub-channel back to the PU.

This cell consists of Ψ number of sub-channels. Then the set of sub-carries can be categorized as, C= {C1, C2 …CΨ}. The Total bandwidth of the cell is B and each sub channel contains the identical quality of sub-carriers. Hence, the bandwidth of each sub-channel must be given by B/Ψ. CQI of any sub-channel is defined using the Signal-To-Interference-Plus-Noise Ratio (SINR) detected by SU-BS during channel allocation and during channel accessing. Signal-To-Interference-Plus-Noise Ratio (SINR), which used to indicate channel capability in a wireless network communication system. SINR is well-defined as the power of interested signal divided by the sum of interference power and the power of arbitrary background noise.

$$SINR = \frac{E_{signal}}{E_{interference} + Noise} \quad (1)$$

Where $E_{interference}$ is signifies the interference power of other signals in the network, E_{signal} Represents the power of the incoming signal of interest. If the power of background noise term $E_{interface}$ =0 then the SINR is reduced to Signal and that signal is reduced to Signal-To-Noise Ratio (SNR). Channel Quality Indicator can be measured at SU-BS by

$$CQI = \log_2(1 + SINR) \quad (2)$$

By limit esteem at the SU-BS, the estimation of CQI measured can be observed and as soon as the SU ask for a channel the CQI estimation of the channel is evaluated and the allocated to the SU on the condition if the CQI>threshold, else the channel is not allotted to the SU. After the channel is relegated to SU in the middle of the information transmission, SU-BS determines degradation in CQI signifying the imminence of PU, the SU hands-off the channel back to the PU. Based on Dynamic Spectrum Allocation for cognitive radio, when a primary user (PU) returns to the band area which cognitive users are using, cognitive radio have to pause the work and transit to another frequency band, this is called spectrum handoff. The switching needs to be done as smooth as possible because the unexpected transition of working spectrum may lead to decreased transmission reliability or even transmission failure.

E. Proposed Algoritham

Step 1: Define Sub-Channel
Step 2: SU requests SU-BS for sub-channel
Step 3: Check CQI at SU-BS
If CQI $\ngtr$ Threshold Value
Then
Request Terminated
Else
Step 4: Check $P_{priority}$ assigned to each SU
Step 5: The highest priority (least $P_{priority}$) is selected from the database at SU-BS.
Then
$P_{priority}$ ++
Step 6: Check queue size
If queue size $\nless$ Threshold value
Then
Goto step 4
Else
Step 7: Idle channel is allocated to SU with the highest Priority and least queue size
Step 8: Check CQI at SU-BS
If queue size $\ngtr$ Threshold value
Then
Request Terminated
Else
Step 9: check $E_{transmitted}$ (i.e. Transmitted power is less than total power allocated to the channel)
If $E_{transmitted} < E_{total}$
Then
Data Transfer takes place
Else
Step 10: Power allocation make at SU allotted with the Sub-Channel
Step 11: Data transfer take place
Step 12: Check CQI at SU-BS
If CQI $\ngtr$ Threshold value
Then
Request Terminated
Else
Step 13: Goto Step 4

V. SIMULTION RESULT

We exploit ns-2 simulation and simulate the proposed algorithm utilizing the Cognitive Radio. At the MAC layer, we use IEEE 802.11.The system field considered for the reproduction is 1000m x 1000m over a level area for 70 seconds of simulation time. All hubs have the same transmission scope of 250 meters. The mimicked movement is Constant Bit Rate (CBR) with a parcel size of 512 B. The reproduction settings and parameters are condensed in Table1

TABLE I. TABLE TYPE STYLES

No. of Nodes	20,40,60,80 and 100
Area Size	1000m X 1000m
MAC Standard	IEEE 802.11
Transmission Range	250m
Simulation Time	70 sec
Traffic Source	CBR
Packet Size	1000Bytes
Sources	4

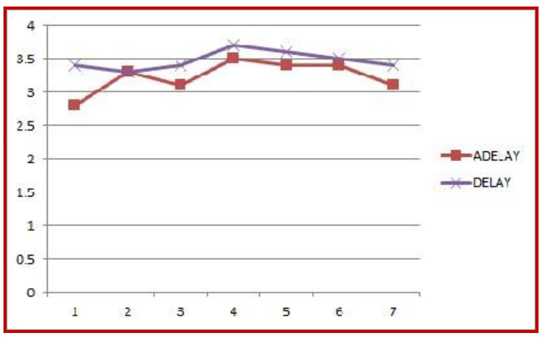

Figure 3. Delay

The above figure shows the graph for delay. The proposed algorithm provides the maximum delay with the application of algorithm is 3.4msec and without applying algorithm is 3.6msec.

VI. CONCLUSION

In CRN, the under-utilization of the radio spectrum should be minimized. Channel sensing and channel selection are the two important tasks in cognitive radio. Various techniques are available for the same. In the proposed technique for data transmission, appropriate channel can be selected by the receiver using priority scheduling algorithm in co-operation with the transmitter. From the graph we can specified that the delay with application of the channel selection algorithm is less compared to the delay without application of proposed algorithm. The proposed algorithm gives SINR ratio is 50.009 dB, path-loss is 0.42 dB and spectral efficiency is 0.017bps/Hz and also avoid collision in CRN. In future we can use this algorithm to improve throughput speed and effective channel utility.

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