A MULTI-USER RESOURCE ALLOCATION OF SPECTRUM SENSING ALGORITHMS USING COGNITIVE RADIO APPLICATIONS

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ABSTRACT:

Joint design of routing and Resource allocation algorithms in cognitive radio based wireless mesh networks. The mesh nodes utilize cognitive overlay mode to share the spectrum with primary users. Prior to each transmission, mesh nodes sense the wireless medium to identify available spectrum resources. Depending on the primary user activities and traffic characteristics, the available spectrum resources will vary between mesh transmission attempts, posing a challenge that the routing and resource allocation algorithms have to deal with to guarantee timely delivery of the network traffic. To capture the channel availability dynamics, the system is analyzed from a queuing theory perspective, and the joint routing and resource allocation problem is formulated as a non-linear integer programming problem. The objective is to minimize the aggregate end-to- end delay of all the network flows. A distributed solution scheme is developed based on, being aware of node localizability, adjustments made by LAL are purposefully selected, avoiding meaningless ranging and communication costs. Second, LAL is light weight, working properly with the existing localization methods (e.g., Sweeps, etc.) without incompatibility. Finally, we implement LAL on a real-sensor network consisting of no of nodes. The deployment data are collected from in-situ measurement in a wild application field.

Keywords*: Resource Allocation, Queuing Theory, Localizability, Distributed Solution, LAL.*

1. INTRODUCTION

By allowing Secondary users to opportunistically access or share the underused spectrum of primary licensed networks, cognitive radio has been distinguished as a promising technology to improve the spectrum utilization efficiency an d meet the stringent requirements in future wireless network. Depending on the spectrum policies laid by a primary system, the dynamic spectrum access mechanism can be generally classified as overlay spectrum and underlay spectrum access. In an overlay based system, SU access the spectrum only when it is not being used by the primary system, whereas in underlay -based system, SU's coexist with the primary system and transmit with power constraints to avoid unacceptable interference and guarantee the QOS of the primary system. Different spectrum access methods require distinct resource allocation strategies. For example, SU's close to or inside the primary system cannot share the channels with PUs and hence uses underlay spectrum, where as SU's located far away from the PU may use underlay spectrum access. For the overlay -based systems, hard-decision resource allocation and probabilistic resource allocation, taking into account spectrum sensing errors are studied in For the underlay based interference among SU's and PU's play a key role in fact, space opportunity was not considered in the existing work .Also Resource allocation strategies for secondary network with location dependent heterogeneous spectrum access have not been studied. An Auction based scheme is proposed to solve power competition of multiple SU. Our resource allocation incorporates the hard decision based approach for overlay and spectrum sharing and sensing free approach for underlay.

It is not a straightforward method to decide whether spectrum sensing for each channel is required. Thus next contribution of this paper is to propose a interference violation test to find out whether channels need to be sensed and further avoid unnecessary spectrum sensing to improve energy efficiency Based on the interference violation test results, the proposed location aware design then incorporates location information to access the spectrum adaptively and achieves improved efficiency.

2. EXISTING SYSTEM

In the existing system, only the Overlay-based systems, hard-decision based resource allocation and the probabilistic resource allocation were taken into account in the spectrum based sensing errors. One Cognitive Radio based system co-exists with one primary system, Secondary users are communicating with a cognitive downlink in the uplink and the Primary Users are receiving signals from a primary base station in the downlink. Assume that for each Secondary User in the Hybrid Region, there is a corresponding worst case Primary User location. All the Primary Users within the coverage area of the primary system are also protected from the transmission of the corresponding Secondary User in long term. The analysis thereafter applies similarly to the secondary downlink scenario and hence this paper focuses on the secondary uplink. Space opportunity, which can enhance the spectrum and energy efficiency, was not considered in most of the existing work. The modules used here are 1) Network Formation and 2) Hard Decision Based Approach.

For the network formation approach we can say that the dynamic spectrum access mechanism can be generally classified as Overlay Spectrum Access and Underlay Spectrum Access, depending upon the spectrum policies laid by a primary system. In the overlay based system, Secondary Users co-exist with the primary system and transmit with power constraints to avoid unacceptable interference and guarantee the Quality of Service (QoS) of the Primary System. Power and channel allocation on Orthogonal Frequency Division Multiplexing (OFDM) based Cognitive Radio network, allowing a Secondary User to adapt its way of accessing the licensed spectrum according to the status of the channel. Here we consider a worst case scenario where a Cognitive Radio co-exists with a primary system and 2 regions are highlighted for the CR system to operate at different spectrum access methods. This is as per the following figure 1.

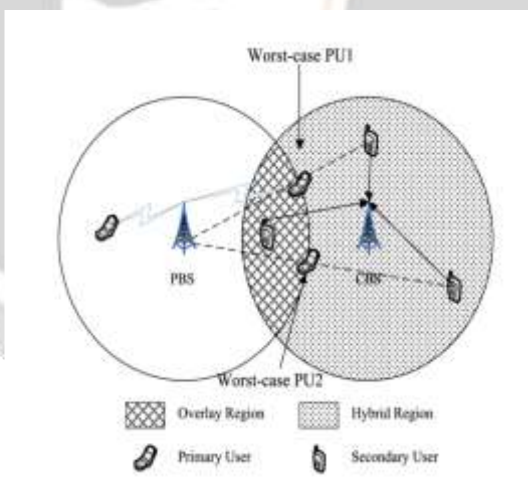

Figure 1. CR co-exists with one primary system and two regions highlighted (uplink scenario for the CR system)

Based on the Hard Decision Based Approach we formulate the complementary QoS issue. The bandwidth of each sub-channel is assumed to be unitary, the minimum data requirements for all the users are assumed to be identical. The overlay based approaches utilize only unoccupied sub-channels based on the sensing results and thus the spectrum sharing indicator for a Secondary User in the Overlay Region is assumed to be null. The Underlay-based approaches allow spectrum sharing and thus we have an unitary value for a Secondary User in the Hybrid Region. Underlay-based systems further utilize those occupied sub-channels with additional protection to the Primary Users. Another resource allocation scheme termed Sensing Free Resource Allocation (SFRA), based on sensing free spectrum access, lets Secondary Users operate on all the sub-channels without spectrum sensing while incorporating the interference constraint. The Resource Allocation needs the sub-channel availability information i.e., the spectrum sensing details. For a given network topology, Cognitive Base Station calculates each Secondary Users' distance to Primary Base Station and determines which region the Secondary User falls into.

Existing solutions to solve the problem involve Destination-Sequenced Distance-Vector (DSDV) protocol which does not resolve all the problems like malicious node, cooperation between nodes, interference, minimization of end to end delay, packet loss and increase throughput maximization in wireless sensor networks as a whole. Destination- Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman–Ford algorithm. The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic or large scale networks. As in all distance-vector protocols, this does not perturb traffic in regions of the network that are not concerned by the topology change.

3. PROPOSED SYSTEM

The previous approach is infeasible due to the total power and interference constraint. So the Location Aware Multi-User Resource Allocation has been used for the proposed system. This method uses dual decomposition approach. Multiple access is achieved in OFDMA by assigning subsets of subcarriers to the individual users. Thus the QoS of the primary system is maintained. As the priority is being given to the QoS parameters, two algorithms namely Recursive Algorithm and Dynamic Threshold Algorithm have been used here. Priority mechanisms are used to optimize the network utilization, while meeting the requirements of each type of traffic. Space priority mechanisms that have been investigated are primarily the Push Out mechanisms and Partial Buffer Sharing (PBS). In both the mechanisms, each source marks every packet with a priority level, indicating high priority and low priority packet.

Cross layer optimization is used for better performance in this proposed method. The proposed design scheme uses LAL Protocol using the Recursive Algorithm can accommodate higher traffic load, and achieve lower delay. LAL Protocol (Recursive Algorithm applied) will improve the other parameters in the Wireless Mesh Network and enhance the performance of wireless mesh network.

4. ALGORITHM IMPLEMENTATION

Localizability Aided Localization approach (LAL) is used which is a fine grained approach. Localization is an accredit approach for many sensor network applications. It abides three aspects: node localizability testing, structure analysis and network adjustment. It applies the Greedy Perimeter State Routing (GPRS) algorithm. Using GPRS the spectrum resources are identified and shared from the Primary User. LAL Protocol finds the best routing performance and by means of this protocol we can achieve a joint design of routing and resource allocation schemes.

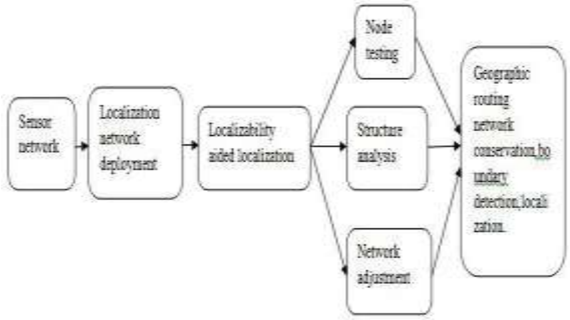

Figure 2. Implementation of LAL

Channel availability is analyzed from queuing theory. Localization is estimated through communication between localized and non localized node for determining their geometric placement. Location is determined by means of distance between the nodes. By means of the Interference Violation Test, spectrum sensing was performed. Thus a better energy efficiency has been achieved in the proposed scheme compared to SFRA.

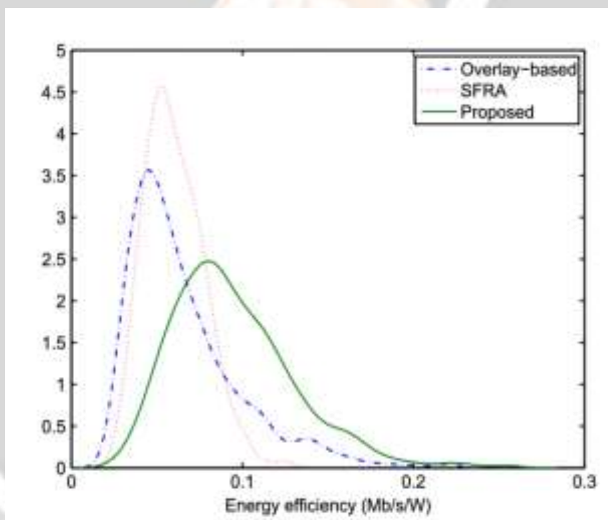

Figure 3. Probability density functions of energy efficiency with different resource-allocation strategies.

5. RESULTS AND CONCLUSIONS

Simulation was performed using NS2.35 software and based on the trace file and AWK file data, the following results were obtained.

Delay has to be reduced in DSDV protocol in order to improve the reliability. Delay for the existing system using DSDV protocol and proposed LAL protocol (Recursive Algorithm) is given below.

Figure 4. Delay analysis

Throughput is the rate of successful message delivery over a communication channel. A higher throughput has been obtained in the proposed system compared to the existing one.

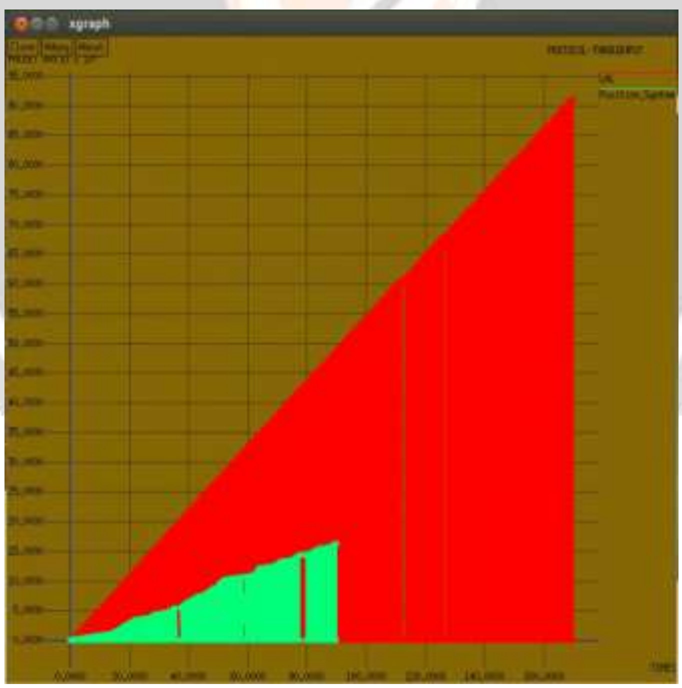

Figure 5. Throughput analysis

Compared to the byte level packet loss occurring in the existing system, the packet losses in the proposed system is much reduced as the losses occurs in bit level.

Figure 6. Loss analysis

Channel measurement refers to the better performance of the communication system. Hence the better channel measurement scheme has been achieved in the proposed system and the simulation results are shown below.

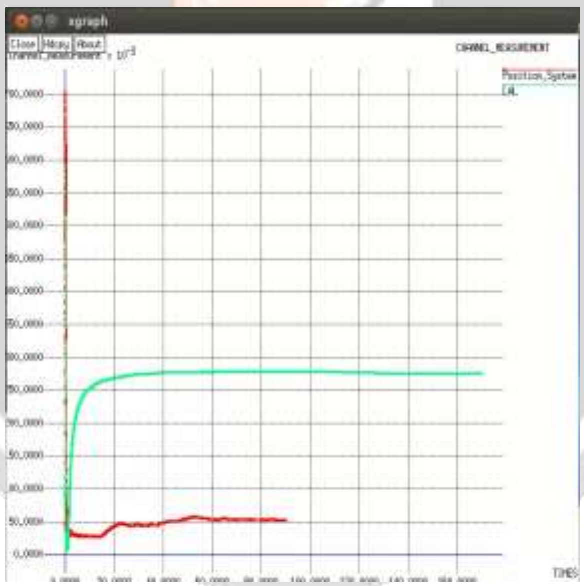

Figure 7. Channel measurement

6. CONCLUSIONS

Here the Localizability aided Localization approach is followed. By means of this end-to-end delay is reduced and the best routing method is found. So the LAL Protocol using the Recursive Algorithm can accommodate higher traffic and achieve lower delay. Using IVT, a better energy efficiency is achieved compared to SFRA. So this enhances the performance of wireless mesh network.

7. REFERENCES

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