IMPROVING THE SPECTRUM AWARE MOBILITY MANAGEMENT IN COGNITIVE RADIO NETWORK

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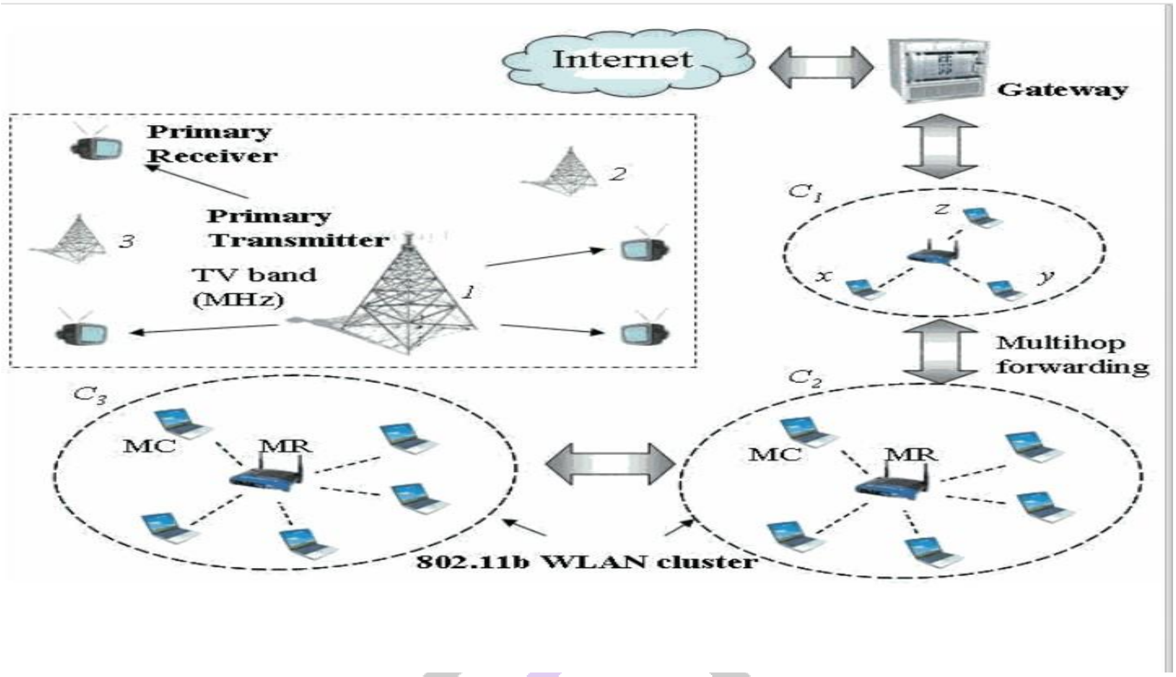
Abstract: Joint design of routing and Resource allocation algorithms in cognitive radio based wireless mesh networks. The mesh nodes utilize cognitive overlay mode to share the spectrum with primary users. Prior to each transmission, mesh nodes sense the wireless medium to identify available spectrum 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 the Lagrangian dual problem. Numerical results demonstrate the convergence of the distributed solution procedure to the optimal solution, as well as the performance gains compared to other design methods. It is shown that the joint design scheme can accommodate double the traffic load, or achieve half the delay compared to the disjoint methods.

Keywords: On Demand Routing Protocol (DORP), Destination-Sequenced Distance-Vector (DSDV) protocol, delay, cognitive, Dynamic Source Routing and Adhoc network.

1. Indroduction

COGNITIVE radio is a promising technology aiming at better utilization of available channel resources by prescribing the coexistence of licensed (or primary) and unlicensed (secondary or cognitive) radio nodes on the same bandwidth. One of the key challenges in the design of cognitive radio networks is the design of dynamic spectrum allocation algorithms, which enable the cognitive nodes to opportunistically access the available wireless spectrum, without interfering with existing primary nodes. Therefore, dynamic spectrum access techniques have received significant attention. In [2] and [3] the cognitive radio problem was investigated from an information theoretic standpoint. The cognitive transmitter is assumed to transmit at the same time and on the same bandwidth of the primary link. Interference is mitigated through the use of complex precoding techniques that require perfect prior information about the primary signal. Hence, controlling the interaction between the routing and the spectrum management functionalities is of fundamental importance. While cross layer design principles have been extensively studied by the wireless networking research community, the availability of cognitive and frequency agile devices motivates research on new algorithms and models to study cross-layer interactions that involve spectrum management-related functionalities. A routing and spectrum selection algorithm for cognitive radio networks was proposed and it chooses the path that has the highest probability to satisfy the demands of secondary users in terms cognitive transmitter is assumed to transmit at the same time of capacity. However, it does not cover the issue of scheduling. In [9], a cross-layer optimization problem for a network with cognitive radios is formulated. The objective is to minimize the required network-wide radio spectrum resources needed to support traffic for a given set of user sessions. The joint routing and resource allocation design has an objective for the minimization of the end-to-end delay and accommodate higher traffic. The performance of the proposed protocol is thoroughly studied and compared to the performance of a disjoint protocol. The disjoint protocol solves the routing problem first and then allocates resources along the constructed routes. The routing metric used favors links with higher primary idle probability while penalizing the total number of hops. The resource allocation part aims at minimizing the end-to-end delay along the preselected routes. Interference is mitigated through the use of complex precoding techniques that require perfect prior information about the primary signal. The concept of a time-spectrum block was introduced in and protocols to allocate such blocks were proposed. The authors derived optimal and suboptimal distributed strategies for the secondary users to decide which channels to sense and access under a Partially Observable Markov Decision Process (POMDP) framework. The cognitive radio concept is desirable for a wireless mesh network (WMN) in which a large volume of traffic is expected to be delivered since it is able to utilize spectrum resources more efficiently. Therefore, it improves network capacity significantly. However, the dynamic nature of the radio spectrum calls for the development of novel spectrum-aware routing algorithms. Spectrum Sharing in CR Networks of the wireless channel necessitates coordination of transmission among the CR users. In the CRAHNs, the sensing schedules are determined and controlled by each user and are not synchronized by any central network entity. Thus, the CR ad hoc users independently perform sensing on an on-demand basis - i.e., when CR users want to transmit or are requested their spectrum availability by neighbouring users. This closely couples the sensing functionality with spectrum sharing among the CR users that is an integral part of the medium access control (MAC) layer coordination



Cognitive radios has the following challenges,

Challenge 1- The spectrum-awareness Designing efficient routing solutions for CRNs requires a tight coupling between the routing module(s) and the spectrum management functionalities such that the routing module(s) can be continuously aware of the surrounding physical environment to take more accurate decisions.

Challenge 2 - Setting up of ‘‘quality” routes in dynamic variable environment and reduce end to end delay The ‘‘route quality” has to be re-defined such that the timely delivery is guaranteed with lower delay less packets loss.

Challenge 3 – Maximum utilization of available spectrum The routing and spectrum management algorithms should ensure maximum utilization of available spectrum and accommodate higher traffic.

The main objective in this work is to find the best routing and resource allocation strategies in order to minimize the average end-to-end delay of multiple data connections in the cognitive radio based wireless mesh network. Because of the primary nodes activity, the spectrum resources available to the cognitive mesh nodes are varying in both space and time. Therefore, any successful routing strategy will have to work closely with the resource allocation strategy in order to make sure that any selected route will have enough resources available to guarantee the required Quality of Services (QoS). Because of this strong interdependence between the routing and resource allocation strategies, we propose to deal with the routing and resource allocation strategies in a joint fashion rather than separating the two problems. Before presenting joint design strategy we need first to analyze the effect of the routing and resource allocation decisions on the network performance. This is achieved by relying on queuing theory to model the different aspects of the cognitive mesh network and to form a basis for our routing and resource allocation protocol design.

2. Existing system:

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. It was developed by C. Perkins and P.Bhagwat in 1994. 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:

We have proposed a design for routing and resource allocation in a joint fashion for cognitive radio mesh networks. We also extend the proposed methodology to be applied in Wireless Sensor networks random and mesh networks using DORP protocol. This methodology using DORP end to delay drastically and increases the maximum throughput. The architecture of Cross Layer Optimization is given below,

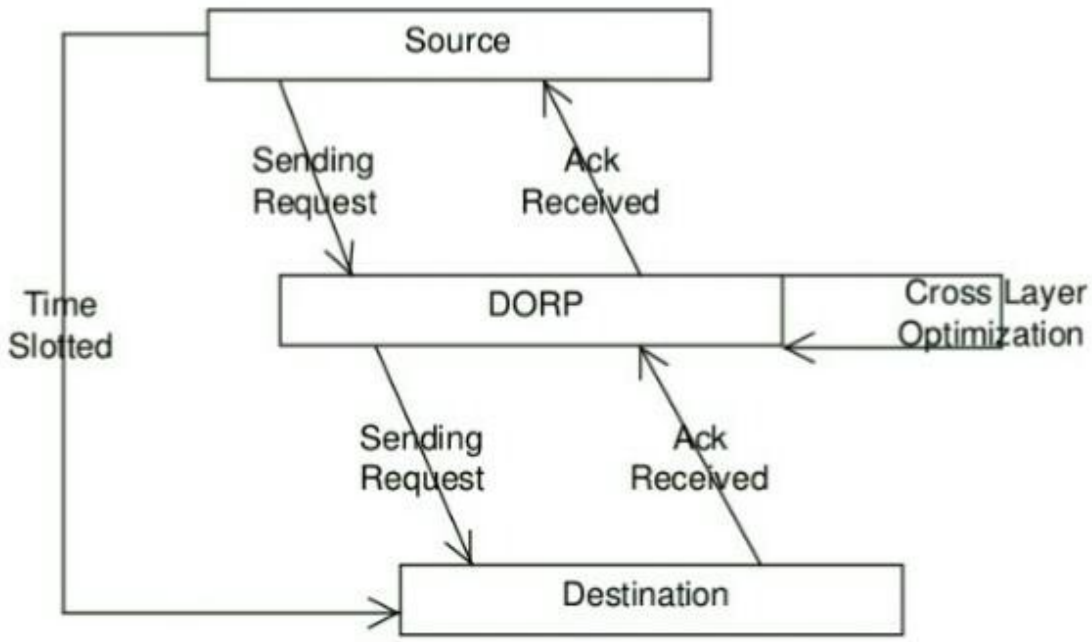


Figure 1: Architecture of cross-layer optimization

Recursive Algorithm: Priority mechanisms are used to optimize the network utilization, while meeting the requirements of each type of traffic. The user may generate different types of traffic flows by using loss priority capability and when buffer overflow occurs, packets from low priority can be selectively discarded by network elements. Priority Mechanism can be classified into two categories time priority and space priority. Time Priority can control the transmission sequence of buffered packets. Space priority controls the access to the buffer. Chipalkatti et al [6] studied the performance of time priority mechanism including Minimum Laxity Threshold (MLT) and Queue Length Threshold (QLT) under mixed traffic of real time and non-real time traffic. Space Priority mechanisms have been investigated primarily are Push out mechanism and Partial Buffer Sharing mechanism. In both this mechanisms each source marks every packet with priority level indicating high priority and low priority. In push out mechanism, high priority packet may enter the queue even when it is full, by replacing the low priority packet in the queue. But if a low priority packet enters the queue when it is full, it will be discarded. In Partial buffer sharing mechanism both high priority and low priority packets are accepted by the queue until it reaches the threshold level.

Mesh network using Cognitive nodes: A wireless mesh network is designed to carry out communication effectively. In this, the mesh node has the capacity of cognitive sensing through which the available spectrum is identified dynamically. The selection of transmitting packets is based on frames which are divided on basis of time. The cognitive node is selected on the basis of sensing capacity of node which is able to accept the request of all other nodes. The cognitive node sends the packet only if the available spectrum is idles. This is used to form a mesh network in which the nodes are represented by each vertex. The cognitive nodes in the network have the same transmission range and the node consists of two edges. Based on primary spectrum the availability for secondary nodes is obtained. In mesh node for sensing of idle nodes during transmission is carried out using Recursive Algorithm. They sense based on space priority and partial input buffer sharing. If cognitive node is not near idle node then the nearest cognitive sensing node is selected based on distance. The cognitive node then transfers the packets in the network by sensing the unused spectrum and allocates the channel for transmission.

Connected Dominate Set(CDS): In this in order to avoid the hidden terminal problem in which the hidden nodes can communicate with other nodes. Only the nodes near cognitive nodes cam communicate in mesh network. So the breaking of mesh is carried out. Then the nodes are deployed randomly so that any node can communicate with cognitive sensing nodes. So DARP protocol is used for routing. This protocol combines all the metrics like delay, losses etc. In this the cumulative delay between the end nodes is calculated. The delay in each route is determined by combining the path delay and node delay.

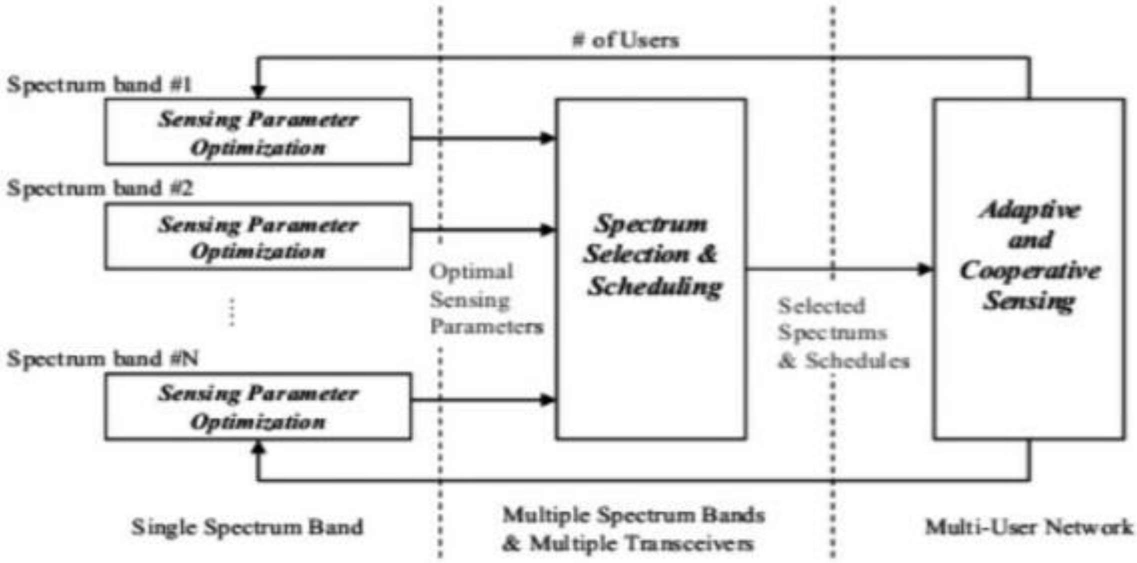


Figure 2: The proposed optimal spectrum sensing framework

4. EXPERIMENTAL RESULTS

The simulation results are given below, where the random network and mesh network is used and the comparison is done on the parameters like delay and packet loss for DSDV and DORP Protocol.

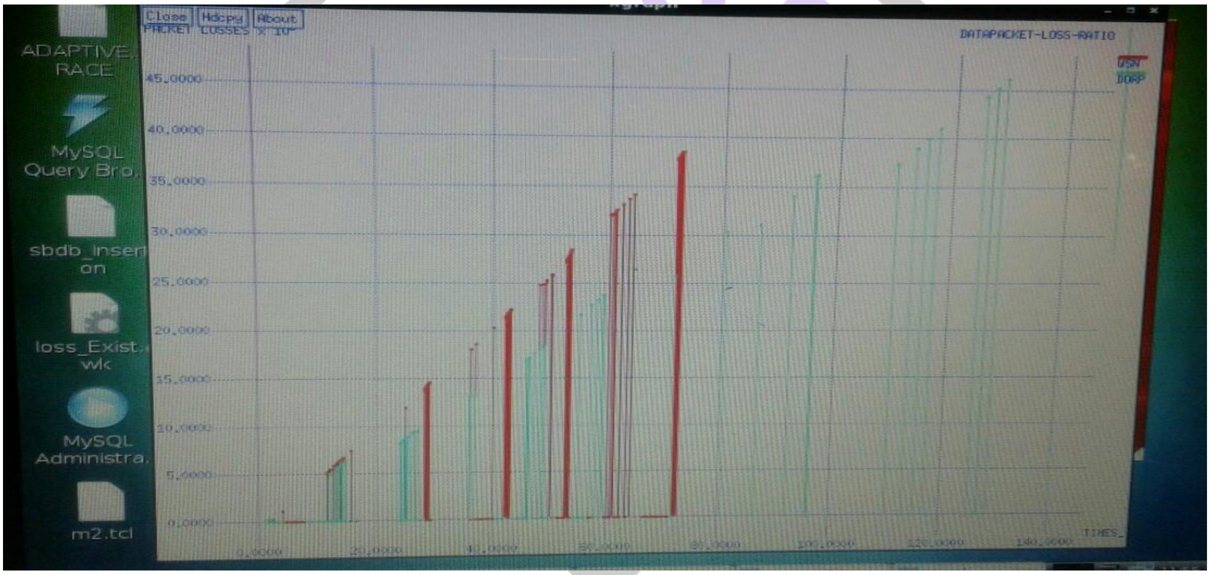


Table 1 Comparison results on Packet loss

Parameter Simulated and Evaluated	DSDV Protocol	DORP Protocol
Packet Loss	Approx. 39%	% Approx. 25%

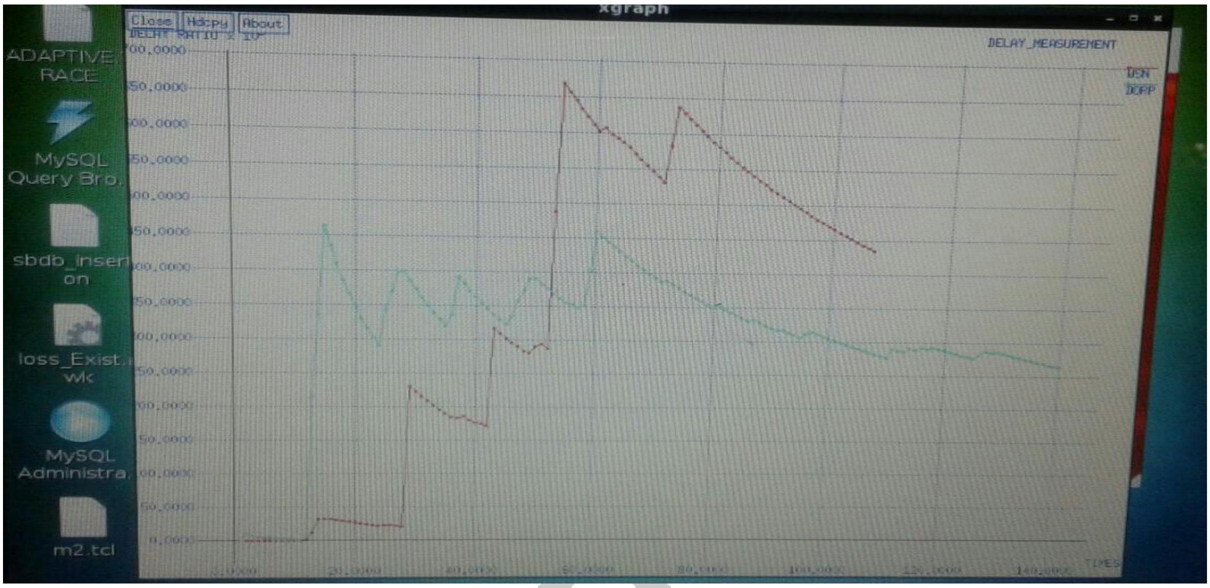


Table 2 Comparison results on end to end Delay

Parameter Simulated and Evaluated	DSDV Protocol	DORP Protocol
Delay Occurrence	Delay is Delay is reduced only after 40% of the packets transmission	Delay is reduced right after 10% of the packets transmission

Advantages;

1. First Come First Serve scheduling methods

2. Decentralized Pre-emptive Scheduling using content delivery Network

3. Decentralized Non- Pre-emptive Scheduling using content delivery Network

4. Space Priority Mechanisms using recursive Algorithm.

5. Partial Buffer Sharing using recursive Algorithm.

4. CONCLUSION:

Joint design of routing and resource allocation schemes in cognitive radio based WMNs. For this class of networks, cross-layer design schemes are crucial since disjoint design strategies lead to lower performance (in terms of delay, or the number of admissible traffic streams) or infeasible solutions in many cases. It was shown that the proposed design scheme with DORP Protocol can accommodate higher traffic load, and achieve lower delay compared to the disjoint design protocol DSDV.

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