Optimize Data Collection in Wireless Sensor Networks Using Multi-Hop Connected Clustering

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ABSTRACT: Cognitive networks enable efficient sharing of the radio spectrum. Control signals used to setup a communication and broadcast to the neighbors in their particular channels of operation. This paper deals with broadcasting challenge specially in multi-hop CR ad hoc networks under practical scenario with collision avoidance have been address. Exchanging control information is a critical problem in cognitive radio networks. Selective broadcasting in multi-hop cognitive radio network in which control information is broadcast over pre-selected set of channels. We introduce the idea of neighbor graphs and minimal neighbor graphs to obtain the necessary set of channels for broadcast. Selective broadcasting reduces the delay in disseminate control information and yet assures successful transmission of information to all its neighbors. It is also confirmed that selective broadcasting reduces redundancy in control information and hence reduces network traffic.

KEYWORDS: Broadcasting, Neighbor Graphs And Minimal Neighbor Graphs.

I. INTRODUCTION

The plan of cognitive networks was initiate to enhance the effectiveness of spectrum utilization. The basic idea of cognitive networks is to allow other users to utilize the spectrum allocated to licensed users (primary users) when it is not individual use by them. These other user who are opportunistic users of the spectrum are called secondary users. Cognitive radio [1] expertise enables secondary users to dynamically sense the spectrum for spectrum holes and use the same for their communication. A group of such self-sufficient, cognitive users communicating with each other in a multi-hop manner form a multi-hop cognitive radio network (MHCRN). Since the vacant spectrum is shared among a group of independent users, there should be a way to control and manage access to the spectrum. This can be achieve using a central control or by a cooperative disseminated approach. In a centralized design, a single entity, called spectrum manager, controls the procedure of the spectrum by secondary users [2]. The spectrum manager gathers the information about free channels either by sensing its complete domain or by integrate the information collected by potential secondary users in their respective local areas. These users transmit information to the spectrum manager through a dedicated control channel. This approach is not possible for dynamic multi-hop networks. Moreover, a direct attack such as a Denial of Service attack (DoS) [3] on the spectrum administrator would debilitate the network. Thus, a distributed approach is chosen over a centralized control. In a disseminated approach, there is no central administrator. As a result, all users should jointly sense and share the free channel. The information sense by a user should be shared with other users in the network to enable certain necessary tasks like route detection in a MHCRN. Such control information is broadcast to its neighbours in a traditional network. Since in a cognitive method, each node has a set of channels accessible, a node receives a message only if the message was send in the channel on which the node was listen to. So, to make sure that a message is effectively sent to all neighbors of a node, it has to be broadcast in every channel. This is called entire broadcasting of information. In a cognitive location, the amount of channels is potentially large. As a result broadcasting in every channel causes a large delay in transmit the control information. Another solution would be to choose one channel from among the free channel for control sign exchange. However, the

possibility that a channel is common with all the cognitive user is little [4]. As a result, several of the nodes may not be available using a single channel. So, it is necessary to transmit the control information on more than one channel to make sure that every neighbour receives a copy [5]. With the raise in number of nodes in the system, it is potential that the nodes are scattered over a huge set of channels. As a effect, cost and delay of communications over all these channels increases. A simple, yet efficient solution would be to identify a small separation of channels which cover all the neighbors of a node. Then use this set of channels for exchange the control information. This concept of transmitting the control signals over a selected group of channels as an alternative of flooding over all channels is called selective broadcasting and forms the basic design of the paper. Neighbor graphs and minimal neighbour graphs are introduced to find the minimal set of channels to transmit the control signals.

II.   EXISTING SYSTEM

Broadcast is an important process in ad hoc networks, especially in distributed multi-hop multi-channel networks. In CR ad hoc networks, different SUs may obtain different sets of accessible channels. This non-uniform channel availability impose special plan challenges for broadcasting in CR ad hoc networks. So we introduce fully-distributed broadcast protocol in a multi-hop CR ad hoc network. In this protocol, control information exchange among nodes, such as channel accessibility and routing information, is critical for the realization of most networking protocols in an ad hoc network. In cognitive network, each node has a set of channels available; a node receives a message only if the message was send in the channel on which the node was listen to. So, to make sure that a message is successfully sent to all neighbors of a node, it has to be broadcast in every channel. In a cognitive environment, the number of channels is potentially large. As a result broadcasting in each channel causes a large delay in transmitting the control information. problem defined in this project1)Broadcasting delay is high.2)Redundancy Occur.3)Sent control information to all nodes.4)High congestion.5)Network traffic is high.

III.   PROPOSED SYSTEM

Broadcasting control information overall channel will origin a large delay in setting up the communication. Thus, exchange control information is a main problem in cognitive radio networks. In our proposed work, we deals with selective broadcasting in multi-hop cognitive radio network in which, control information is transmit over pre-selected set of channels. We establish the concept of neighbor graphs and minimal neighbor graphs to derive the essential set of channels for transmission. Neighbor graphs and minimal neighbor graphs are introduced to find the minimal set of channels to transmit the control signals. A neighbor graph of a node represents its neighbors and the channels over which they can communicate. A minimal neighbor graph of a node represent its neighbors and the minimum set of channels through which it can reach all its neighbors. Advantages of proposed system.1)Control information is transmitted over pre-selected set of channels.2)Network traffic is reduced3)Low Broadcasting delay4)Less congestion, contention5)No common control channel6)Redundancy reduced.
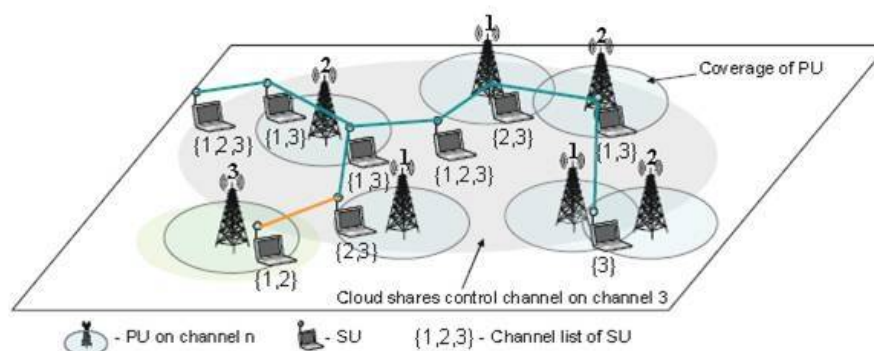

Figure 1.Architecture Diagram

IV. SELECTIVE BROADCASTING

In a MHCRN, each node has a set of channels presented when it enters a network. In order to become a part of the network and start communicate with other nodes, it has to initial know its neighbors and their channel information. Also, it has to let other nodes know its occurrence and its accessible channel information. So it broadcasts such information over all channels to make sure that all neighbors obtain the message. Similarly, when a node wants to start a communication it should replace certain control information useful, for example, in route discovery. However, a cognitive network location is dynamic due to the primary user's traffic. The number of available channels at each node keeps changing with time and location. To keep all nodes efficient, the information change has to be transmitted over all channels as quickly as possible. So, for successful and efficient coordination, fast dissemination of control traffic between neighboring users is required. So, minimal delay is a important factor in promptly disseminating control information. Hence, the goal is to decrease the broadcast delay of each node.

Now, consider that a node has M available channels. Let Tb be the minimum time required to broadcast a control message. Then, total broadcast delay = M ×Tb. So, in order to have lower broadcast delay we need to reduce M. The value of Tb is dictated by the particular hardware used and hence is fixed. M can be reduced by discovering the minimum number of channels, M ' to broadcast, but still making sure that all nodes obtain the message. Thus, communications over carefully selected M' channels instead of blindly broadcasting over M (presented) channels is called Selective Broadcasting. Finding the minimum number of channels M ' is accomplished by using neighbor graphs and discovering the minimal neighbor graphs. Before explaining the idea of neighbor graph and minimal neighbor graph it is essential to understand the state of the network when selective broadcasting occurs and the difference among multicasting and selective broadcasting.

A. State Of The Network

When a node enter in the network for the first time, it has no information about its neighbors. So, initially, it has to broadcast over all the feasible channels to reach its neighbors. This is called the initial state of the network. From then on, it can begin broadcasting selectively. Network steady state is reached when all nodes know their neighbors and their channel information of each node. Since selective broadcasting starts in the steady state, all nodes are assumed to be in steady state during the rest of the conversation.

B. Multicasting And Selective Broadcasting

Broadcasting is the environment of wireless communication. As a result, Multicasting and Selective broadcasting might appear related, but they change in basic idea itself. Multicasting is used to send a message to a specific group of nodes in a particular channel. In a multichannel environment where the nodes are listening to different channels, Selective broadcasting is an essential way to transmit a message to all its neighbors. It uses a selected set of channels to transmit the information instead of broadcasting in all the channels

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V. NEIGHBOR GRAPH AND MINIMAL NEIGHBOR GRAPH FORMATION

In this section, the design of neighbor graph and minimal neighbor graph is introduced and the construction of the same is explain. A neighbor graph of a node represent its neighbors and the channels over which they can communicate. A minimal neighbor graph of a node represents its neighbours and the minimum set of channels through which it can reach all its neighbors. The complete construction of both such graphs is explained below.

A. Construction Of Neighbor Graph

Each node maintains a neighbor graph. In a neighbour graph, each user is represented as a node in the graph. Each channel is represent by an edge. Let graph G denote the neighbor graph, with N and C representing the set of nodes and all possible channels, correspondingly. An edge is added between a pair of nodes if they can communicate through a channel. So a each nodes can have 2 edges if they can use two different frequencies (channels). For example, if nodes A and B have two channels to communicate with each other, then it is represented as shown in Fig. 2a. A and B can communicate through channels 1 and 2. hence, nodes A and B are connected by two edges.

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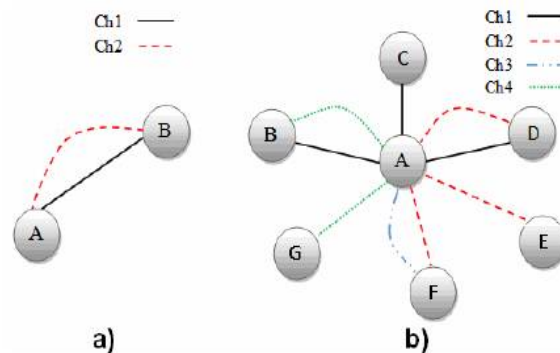
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Figure 2. a) Nodes A and B linked by 2 edges. b) Representation of node A
with 6 neighbors

consider a graph with 7 nodes from A to G and 4 different channels as shown in Fig. 2b. Node A is considered the source node. It has 6 neighboring node, B through G. The edges signify the channels through which A can communicate with its neighbors. For example, A and D node can communicate through the channels 1 and 2. It means that they are neighbors to each other in channels 1 and 2. So this graph is called the neighbor graph of node A. Similarly every node maintains its neighbor graph.

B. Construction Of Minimal Neighbor Graph

To decrease the number of broadcasts, the minimum number of channels through which a node can reach all its neighbours has to be chosen. A minimal neighbor graph contain set of channels. Let DC be a set whose elements represent the degree of each channel in the neighbor graph. So, DC_i represents the number of edges corresponding to channel C_i. For example, the set DC of the graph in Fig. 2b is: DC ={3,3,1,2}. To build the minimal neighbor graph, the channel with the highest degree in DC node is chosen. All edges corresponding to this channel, as well as all nodes other than the source node that are associated to these edges in the neighbor graph, are removed. This channel is added to a set called 'Essential Channel Set', ECS which as the name imply, is the set of required channels to reach all the neighboring nodes. ECS originally is a null set. As the edges are removed, the corresponding channel is added to ECS.

For example, review the neighbor graph shown in Fig: 2b. The step wise formation of a minimal neighbor graph and the ECS. ECS is set to void. Since channel 1 has the highest degree in DC node, the edges corresponding to channel 1 are removed in the initial step. Also, nodes B, C and D are removed from the graph and channel 1 is added to ECS. It can be seen that sets DC and ECS are reorganized for the next step. This process continues until only the source node is left. At this point ECS contains all the necessary channels. The minimal neighbor graph is formed by removing all the edges from the original neighbour graph, which do not correspond to the channels in ECS. The final minimal neighbor graph is shown in Fig. 2. Since, ECS is constructed by adding only the required channels from C; ECS is a subset of C.
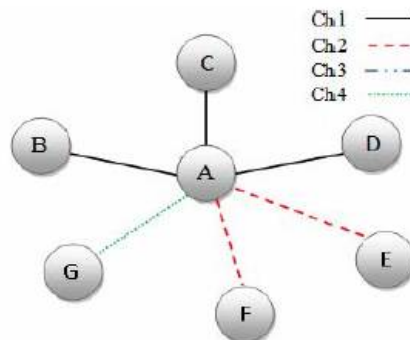
Figure 3. Final minimal neighbor graph of fig. 2b.

VI. PERFORMANCE EVALUATION

In this section the performance of the selective broadcast is compared with complete broadcasting by studying the delay in broadcasting control information and redundancy of the received packets. The performance evaluation used in all these experiments is shown below. For each experiment, a network area of 1000m×1000m is considered. The number of nodes is different from 1 to 100. All nodes are deployed randomly in the network. Each node is assign a random set of channels changing from 0 to 10 channels. The transmission range is set to 250m. Each data point in the graphs is an average of 100 runs. Before looking at the routine of the proposed idea, two observations are made that help in understanding the simulation results. Fig. 3 shows the plot of channel spread as a function of number of nodes. Channel spread is defined as the combination of all the channels covered by the neighbors of a node.
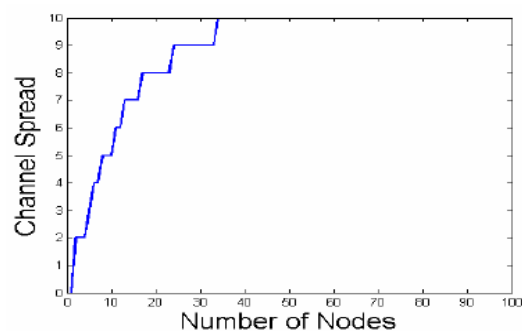

Figure 4 Plot of channel spread with respect to number of nodes for a set of
10 channels.

A. *Broadcast Delay*

In this part transmission delay of selective broadcast and complete broadcast are compared. Broadcast delay is defined as the total time taken by the node to effectively broadcast one control message to all its neighbors. Each point in the graph is the average wait of all nodes in the network. The minimum time to broadcast in a channel is assumed to be 5 msec.

In selective broadcasting the delay in disseminating the control information to all neighbours of a node is reduced amount of the complete broadcast. In selective broadcasting, the delay increases with the number of nodes because, it increase the number of nodes and the nodes are spread over increased number of channels. As a result, a node may have to transmit over a large number of channels. In complete broadcasting, a node transmits over all its

obtainable channels. Since these channels are assign randomly to each nodes, the average number of channels at each node is almost constant.

The average delay increases linearly with large number of channels in the case of successful broadcast, because the node transmit in all its available channels. On the other hand, in selective broadcasting, the rate of increase in delay is small. This is because, increasing the amount of channels, the number of neighboring nodes enclosed by each channel also increases. As a result, the minimum channel set required to cover all the neighbors remains constant and keeping the delay constant.

B. *Redundancy*

'Redundancy' is defined as the total number of additional copies of a message received by all nodes in the network if all of them transmit control messages once. It is observed that the number of redundant messages increases with amount of nodes in both the cases and the curve are similar in shape. This implies that the difference in redundancies is not a purpose of the number of nodes. The average M to M ' ratio was found to be 2.5. This concludes that the reduced total redundancy is due to the reduction in channel set in selective broadcast. It has been verified that redundancy is reduced by a factor of (M /M ').

The rate of increase of redundancy is lower in selective broadcast when compared to successful broadcast. In complete broadcast, the number of redundant messages at each node is equal to the number of channels it has frequent with the sender. Therefore, with increase in number of channels the redundant messages approximately increase linearly whereas in selective broadcast the increase is small due to the selection of minimum channel set. In this section, it has been demonstrated that selective broadcasting provides lower transmission delay and redundancy. It should be noted that, due to the decrease in redundancy of messages, there will be less congestion in the network and hence, there is possible for improvement in throughput by using selective broadcasting.

VII. CONCLUSION

In this paper the concept of selective broadcasting in MHCRNs is introduced. A minimum set of channels called the Essential Channel Set (ECS), is derived by neighbor graph and minimal neighbor graph. This set contains the minimum number of channels which cover up all neighbors of a node and hence transmitting in this selected set of channels is called selective broadcasting is compared to complete broadcast or flooding. It performs better with increase in number of nodes and channels. It has also been exposed that redundancy in the network is reduced by a factor of (M /M '). As a result there is a possible for improvement in overall network throughput.

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