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Analysis of Decentralized on Demand Cross Layer in Cognitive Radio ad hoc Network

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ABSTRACT: Cognitive radio ad hoc networks different unlicensed users may acquire different available channel sets. This non-uniform spectrum availability imposes special design challenges for broadcasting in CR ad hoc networks.Cognitive radio automatically detects available channels in wireless spectrum. This is a form of dynamic spectrum management. Cross layer optimization is proposed, using this can allow far away secondary users can also involve into channel work. So it can increase the throughput and it will overcome the collision and time delay.

KEYWORDS: Cognitive radio ,Cross layer optimization, CR mesh network.

I. INTRODUCTION

Cognitive radio which is used to create a paradigm of designing wireless communication system that will help to enhance the usage of radio frequency(RF)spectrum. Role behind CR is the insufficient of the available frequency channel spectrum ,high demand which is caused by the emerging wireless applications for mobile users. Many large number of the available radio spectrum would be already allocated for the existing wireless spectrum. However, a small part of this can be licensed to new wireless spectrum application. The study by the spectrum policy task force(SPTF) of the federal communication commission(FCC) has been displayed some of the frequency channel band that are frequently used by the licensed channel in a particular time and location, but one of many frequency bands that can only partly occupied or largely unoccupied. The main method is to lead the inefficient use of radio spectrum is the spectrum licensing scheme itself.Using Cross layer optimization technique secondary far away distance channel also will involve into licensed network by using recursive algorithm and dynamic threshold algorithm using 2 acknowledgement scheme.so , it can avoid the time delay and to avoid the collision involved between the mesh network topology.

II. BACKGROUND AND RELATED WORK

Distributed Resource Optimization

CR ad hoc networks, without the information about the channel used for broadcasting and the exact delay for a single-hop broadcast to predict when and on which channel a broadcast collision occurs is extremely difficult.a broadcast protocol which can avoid broadcast collisions,as well as provide high successful broadcast ratio and short broadcast delay is a very challenging issue for multi-hop CR ad hoc networks under practical scenarios.Simply extending existing broadcast protocols to CR ad hoc networks cannot yield the optimal performance.

A. i)Random Routing without Mesh Topology

The wireless mesh network is a leading technology that can help for multimedia applications. Multimedia applications have quality of service(QOS). Moreover, random topology deployment leads to have some unused network resources. Therefore resources optimization is one of the most critical design issues in multi-hop, multi-radio wireless mesh networks enabled with multimedia applications. Resource optimization will be studied usually in survey for wireless ad hoc & sensor networks. Wireless mesh networks(WMNs) are dynamically self-organized, self-configured, self-healing and easy to install multi-hop networks.

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ii) A Distributed Broadcast Protocol and Resource Allocation

Crosslayer optimization protocol is particularly designed for broadcast scenarios in multi-hop CR ad hoc networks without a common control channel.construction of the broadcasting sequences and distributed broadcast scheduling scheme and broadcast collision avoidance scheme. Construction of the Broadcasting Sequences:The broadcasting sequences are the sequences of channels by which a sender and its receivers hop for successful broadcasts. Distributed Broadcast Scheduling Scheme : broadcast scheduling scheme is fully distributed. In addition, since the node with the smallest w is selected for rebroadcasting,the broadcast delay is the shortest. Moreover, because only a subset of intermediate nodes are selected to rebroadcast, the number of intermediate nodes that need to forward the message is reduced. Thus, the probability that multiple senders broad- casting to the same receiver simultaneously can be reduced. Hence, the proposed broadcast scheduling scheme also contributes to the broadcast collision avoidance Broadcast Collision Avoidance Scheme:broadcast collision avoidance methods in traditional ad hoc networks assign different time slots to different intermediate nodes to avoid simultaneous transmissions. ,these methods cannot be applied to CR ad hoc networks because the exact time for the intermediate nodes to receive the broadcast message is random.

III. PROPOSED SYSTEM:

Cross layer optimization technique is proposed so that can avoid broadcasting collision. By using the algorithm with mesh CR have the two steps used to implement the distanced far away channels to be in channel work i)with CR ii) without CR. In this with CR it use recursive algorithm. In this recursive algorithm divided into two types i)space priority ii)partial buffer sharing and the another algorithm used is without CR Dynamic threshold algorithm using 2 acknowledgement scheme. And the another algorithm called without mesh ,in that the scheme is random resource optimization. By using this can avoid time delay and collision.

Random routing optimization network

The issue of multi-hop ad hoc dynamic spectrum networks is to overcome the dynamic spectrum network that focusing on unique performance evaluation. Secondary devicesart another-generation cognitive radio deviceswho opportunistically exploit locally unused licensed spectrumwithout disrupting operations of primary devices. Secondarydevices that detect the presence of a primary devices on achannel must switch to other channels.where two secondary users communicate in the presence of 3primary users. No single channel is available across the entirepath, and the two endpoints must use assign different channelsto each link to avoid disrupting nearby primary users.

With mesh topology

The proposed scheme for active spectrum handoff that is published which is based on multi-user that can be improved by cross layer optimization algorithm. In this section, all the non-licensed users for starting a network spectrum handoff that will be searched spectrum handoff and select for that best channel based on two proposed criteria. One is selecting the minimum service time and the second is to selecting based on maximum free time .There are Mchannel and K secondary users in the network. starts the transmission to SU-2 in channel 3 in the first slot. After 11 slots the PU-appears in channel 3 and wants to initiate a new transmission.

Our problem context is multi hop, ad hoc, dynamic spectrum network. Next we briefly overview dynamic spectrum networks, focusing on unique properties that distinguishes them from conventional multi-channel networks.

A. Dynamic Spectrum Networks

There are two types of devices in a dynamic spectrum network. That can be aware ofown licensed spectrum but do not fully utilize it. Secondarydevicesare next-generation cognitive radio devices who opportunistically exploit locally unused licensed spectrum without disrupting operations of primary devices. Secondary devices that detect the presence of a primary devices on a channel must switch to other channels.

B. Related Work

To managing spectrum usage can have two network architecture .The node coordination of distributed architecture . An overview of existing solution that can be found in an references. In single-hop architecture that works differs from the multi-hop ad hoc network. The topology that willoptimized and networks based multi-radio solution are not applicable to the problem. So, the system is ad hoc with arbitrary topology.

IV. ROUTING IN DYNAMIC SPECTRUM NETWORKS

Routing protocols for dynamic spectrum networks should exploit the flexibility and power of cognitive radios while addressing unique challenges not present in traditional networks.Next, we discuss the challenges on routing in dynamic spectrum networks and consider the feasibility of applying approaches previously proposed for conventional networks.

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A. The Impact of Heterogeneous Spectrum Availability

Because secondary devices must yield to primary users,their available spectrum is location-dependent and hence heterogeneous across the network. In the example in Figure 2, the introduction of primary users has produced three islands with heterogeneous spectrum availability. To set up multihop connections between node pairs with different spectrum availability, intermittent bridge nodes have to switch between multiple channels. That is, links on each path need to communicate.Using random topologies, we examine the probability of finding a route between any two nodes, if links on each route are restricted to use a single channel, or if they can use different channels. It compares the success rate under different impact range values of primary users, normalized over the secondary user's transmission range. We see that having a single-channel per route becomes an exception. To avoid rejecting connections, it is crucial to allow links on each path to user different channels. Finally, when primary user's impact area become fairly large, the usable channels diminish.

B. Examining Existing Approaches

The lot of approaches have been find for the number of routing in conventional one-radio and two-radio channel wireless system. That will be examine the approach can be addressed in a dynamic spectrum network. First, flow- or component-based approaches use a single channel per flow or connected component .It shows that the presence of heterogeneous spectrum regions often breaks this assumption, resulting in numerous rejected flows. One extension is to use different channels in different sections of the path. Finally, any changes in spectrum availability will requirereconfiguration of the entire flow or connected component,significantly disrupting application traffic. Second, the decoupled channel assignment for the number of distributed link based on routing by allowing link based on choosing and maintains the nearby connectivity.While this enables each node to choose channels based on local availability, it is known to be flow-unaware, and cannot optimize end-to-end multi-hop performance [15]. Existing link-layer approaches use per-link per-timeslot channel assignment [14], which can produce suboptimal channel assignments and control message contention.

C. Routing across Heterogeneous Spectrum Regions

After examining current approaches, we conclude that to route across regions of number of heterogeneous network spectrum availability in the form of dynamic spectrum allocation of 2 ack scheme, we need a distributed end-to-end approach to optimize route performance, while allowing flexibility in channel usage to cope with spectrum heterogeneity. We propose cross layer optimization, a new routing protocol for high-throughput multi-hop routing in dynamicspectrum systems. The unique properties of cross layer optimization include:

• Integrate spectrum discovery with route discovery to cope with spectrum heterogeneity, and obtain optimal usage ofavailable channels.
• Coordinate channel usage explicitly across nodes to optimize channel assignment on a per-flow basis, and to minimize inter-flow interference and interference.
• Exploit local spectrum heterogeneity and assign different channels to links on the same flow to minimize intra-flow interference.

Finally, BRACER is distributed and incurs low computational and communication complexity. Utilizing spectrum heterogeneity.

V. BRACER PROTOCOL DESIGN

In this section we describe in detail the BRACER protocol.Each device have one control radio and one data radio. In mesh networks which is different from conventional multi-radio devices. Next, is to begin with an overview and the explanation of the every component. We illustrate the high level operation of BRACER using an example. AnodeS seeks a multi-hop interference-free path to destination D.First to initiates S have a connection to D by forming SpectrumawareRoute Discovery. It broadcasts an route discovery message to its neighbors, who forward them on. In addition to locating a forwarding path to D, thesemessages also accumulate information about each node'savailable channels (those not used by primary users and not reserved by other flows).however, BRACER allows multiple paths to propagate to the destination. To avoid broadcast congestion, nodes eliminate routing loops and useper-flow state to limit the number.

Second, the route selection and scheduling performs in destination D. The maximum point of end-to-end throughput that choosing the optimal route. Next, the routing setup& channel reservation information have to be determined its channel usage & to be interference into explicit channel reservation. Finally, the primary users will have the channel availability usage that will performs the local adaptation will be modifying their connectivity . Finally, as channel availability changes with the actions of primary users, nodes perform Local Adaptation by modifying their local

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channel usage to maintain flow connectivity. If local adaptations fail, BRACER invokes routinglevel route repair mechanisms to restore the path. We now describe BRACER components in further detail.

A. Spectrum-aware Route Discovery

The heterogeneous spectrum availability provide robust connectivity. The spectrum sensing that integrates traditional demand routing discovery. It maintains the available routing channels that are occupied by the neighbor primary users that are formed by the BRACER protocol. The node that performs the broadcasting spectrum availability. A BRACER nodeS performs spectrum-aware route discovery by broadcasting a RouteRequest (RREQ) message on the dedicated controlchannel, with its channelSet AS inside. Each RREQ message is uniquely identified by the source and destination IP addresses.As node I receive a RREQ message, it first examines the current partial path for its own address. If found, ihasforwarded this message before, and now drops it in order to break the routing loop. Otherwise, i checks to see if it shares a common channel with the previous hop node. If so,Iappendits identifier and its channelSet Ai to the payload,andbroadcast the message. Otherwise, this link canestablish, and the RREQ is dropped. We illustrate the steps in RREQ.

Minimizing RREQ **Traffic.**

The traditional routing discovery protocol needs to discover various paths to reach their destination. The all possible paths are sent and the paths are redundant are not suppressed for the routing selection.We use two mechanisms to reduce the amount of RREQ broadcast traffic. First, we can limit the number of routes forwarded by each node using a parameter Pmax. Each node keeps a per-flow counter, and only forwards the first PmaxRREQ messages. Second, when the destination node D receives the first RREQ, it starts a per-flow timer TR .The channel performs the optimal routing that selects the D can expires TR based routing received assignment channel, received and sends the source on routing protocol. All notified nodes will drop additional

Intersecting Flows The TDMA uses the style channel that scheduling a flow obtains maximum throughput it will not interest the flow. The end-end throughput that will reduce another flow.Under certain topologies however, the only path between two nodes intersects with an existing flow.When a RREQ messagesreaches a node ialready servicing a flow, it records thenumber of existing flows on iand their time schedules. Thenumber of existing flows serviced defines a throughput limit for any path crossing i. Crossing one flow intersection means aflow's maximum throughput is limited to half of optimal. Anyadditional intersections after the first does not incur furtherthroughput degradation, since the flow is already sending at half of the maximum rate. We discuss in Section IV-B howthe destination utilizes this information during route selection.

B. Route Selection and Scheduling

During route discovery, multiple RREQ messages are forwardedalong different paths towards the destination D. Onar rival, each RREQ message encodes a full path from thesource. For each node on the path, it provides its identifier (IP), available channel Set, and the time schedule of any flows it isservicing. Upon receiving the first RREQ messages for a given flow, D starts a timer TR, and collects all RREQ messages until TR expires. Subsequent RREQ messages for the flow are dropped. In this section, we describe in detail how destinationD analyzes its set of received paths to select the best routeand compute its optimal channel and time slot assignment.

Route Selection.

The destination D can use a variety of policies to determine the most desirable route. By observing the number of flows at any intersections along a route, D can estimate the route's maximum throughput. D can also seek to minimize end-to-end latency by choosing routes with lower hop-count. Finally, wecan also consider quality-based metricssuch as ETX [3], ETT, WCETT [5], by embedding each link's quality into the RREQ message. In general, the destinationcomputes a policy-driven utility value for each candidate routebased on a combination of the above factors, and selects the route with the highest utility. In our implementation, we select routes by sorting on maximum possible throughput.

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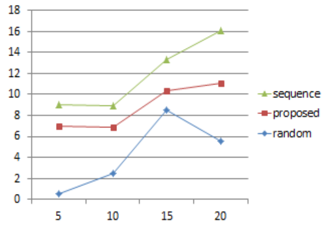

Channel Assignment and Scheduling. Using information from RREQ messages, D computes a per-hop channel usage schedule for the route it has chosen. By combining the available channel set from link endpoints, each link now has a list of available channels that will not disrupt primary users or interfere with neighboring flows. The propose scheduleassigns each link with a channel from its availability list. Italso avoids self-interference by assigning orthogonal channelsto conflicting links on the flow. Because the data radio ishalf-duplex, we divide time into equal-sized time slots, witheach device alternating between transmit and receive modeson consecutive time slots.The problem of channel assignment can be reduced into agraph coloring problem by mapping each link into a vertexand its availability list as the color list. If two links conflictthen they are connected in the conflict graph. Links that areon even and odd time slots will form two conflict graphs. Theoptimal assignment is to use the minimum number of colorsto color each vertex with a color from its list, so that no twoconnected vertices have the same color. We use a heuristicbasedapproximation that colors vertexes iteratively, each timeselecting the vertex with the fewest colors available.

Scarce Spectrum Scenarios. In rare circumstances, aconcentration of primary users can result in sporadic channel availability insufficient for conflict-free channel/slot assignments. One solution is to divide time into shorter slots to create additional “logical” orthogonal channels, at the cost of finer grain time synchronization. We propose a simple alternative: allow selective links to share a channel with its conflicting neighbors by using CSMA/CA to avoid self-interference. Following channel assignment and scheduling, D sends the per-hop channel schedule and protocol setting in a Route Reply(RREP) message along the path back to the source node.

C. Reservation-based Route Management

Nodes use explicit channel reservation messages to coordinate channel usage. This implies that BRACER nodes need to have the knowledge of conflicting nodes. We noticed that there have been considerable contributions on interference discovery supported by testbed verifications, such as .In addition, measurement results have verified the assumption of 2-hop interference model for indoor networks. Therefore, we assume that cognitive radios can incorporate some of these features

with its sensing capability to reliably discover interfering neighbors. In this paper, for simplicity, we assume a 2-hop interference model. Next, we briefly describe how SPEAR uses soft-state reservation announcements in both route setup and teardown.

Route Setup. If a node is transmitting data, it must broadcast

periodic channel reservations that announce its channel use. When a node receives a RREP message, it schedules its channel usage according to the defined schedule, and either modifies its existing reservation broadcast (if it had been idle). Each reservation has an implicit timeout period TL during which it is valid. This soft-state approach ensures simplifies management and provides robustness against node failures and node mobility. To minimize broadcast overhead and contention, each reservation message has a time-to-live (TTL) field that limits its reach to neighbors within the sender’s interference range.

Route Teardown.SPEAR handles route teardowns implicitly. When a flow terminates, nodes along the path are notified to stop sending reservation messages. Channels whose reservations have timed out are assumed to be open. If faster channel reuse is desired, nodes along the path can send an explicit teardown message to revoke existing reservations.ns or begins a new reservation

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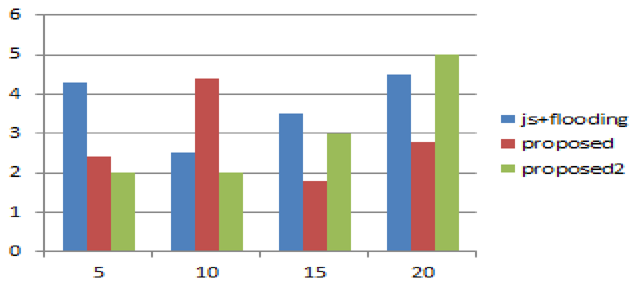
VI. SIMULATION RESULTS

We evaluate SPEAR performance using Quaint simulations on a 1000m x 1000m grid. Unless specified otherwise, we assume a traffic model consisting of unidirectional UDP traffic. Each node is equipped with a single half-duplex cognitive radio for data transmission and a single half-duplex normal radio for control transmission. The available spectrum is divided into 12 channels. Each cognitive radio can access one channel at a time, while primary users can claim multiple channels simultaneously. Both the cognitive and control radios are configured for a data rate of 12Mbps. In BRACER, each cognitive radio follows 85ms time slots with two 5ms guard band, with channel switching delay of 80us. The control radio uses the 802.11 CSMA/CA MAC protocol. To simulate spectrum heterogeneity, we use the scenario.



A. BRACER Protocol Overhead
In SPEAR, on-demand route discovery messages and periodicchannel reservation messages are the two main sourcesof protocol overhead.First we examine the route discovery overhead in terms ofroute setup and tear-down delay.
B. Aggregated System Throughput
We compare the aggregate system throughput of BRACER with an optimistic Flow-based scheme where each flow is assigned a channel that does not conflict with neighboring flows.

Homogeneous Spectrum Availability First we examine the aggregate system throughput under homogeneous spectrum conditions without any primary users. This scenario presents a spectrum rich environment where all the channels are available for data communication, which is ideal for evaluating the peak performance of BRACER and flow-based scheme. plots the aggregate system throughput of BRACER and Flow-based scheme as a function of the number of flows in the system. BRACER achieves a twofold gain over Flow-based routing for both heavy and light traffic conditions. We observe that BRACEER achieves almost twice the performance of Flow based scheme. This is primarily because BRACER eliminates intra flow interference using a non-conflicting channel assignment on each path, resulting in higher per flow throughput.

Heterogeneity Spectrum Availability We now examine SPEAR's throughput performance in the presence of primary users. Using the scenario in Figure 2 we place two primary users at diagonally opposite corners of the grid, and a third primary user at the center of the grid. While the primary users at the diagonally opposite corners occupy channels 1 to 6, the primary user at the center of the grid For 30 randomly chosen source-destination pairs, Figure 8 shows the aggregate system throughput of BRACER and the Flow-based scheme as the normalized primary user impact range is increased. We see that even when primary users impact a large part of the network, SPEAR achieves significant improvement over Flow-based approach. This is because the following two reasons. First, due to the spectrum aware property, the success rate of end to end path discovery is significantly higher in SPEAR than in the Flow-based scheme. Second, while intra-flow interference limits per-flow throughput in the Flow-based scheme, SPEAR maintains a higher throughput by eliminating intra-flow interference. copies channels 5 to 12.

C. BRACER vs. Link-based Approach We compare BRACER with the link-based approach using an approximation of MMAC .In this experiment, we use a simple linear topology favorable to the MMAC protocol. In a random topology, neighbor links would compete for links, producing large control contention.

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We compare the best and worst case performance of BRACER with MMAC. While in the best case, BRACER uses a minimum of 2 channels to perform a non-conflicting channel assignment for the path, in the worst case all the links are forced on to a single channel due to the availability of a single common channel at each node. We use the even-odd time slot structure for both the best and worst case evaluation. The MMAC system is configured to use all the 12 channels. As a reference, we also plot the throughput of the flow-based approach. Figure 9 illustrates the average flow throughput performance. In the best case, BRACER's flow throughput is constant regardless of the hop count. In the worst case, however, the throughput decreases initially and then remains constant. This degradation in throughput is due to the contention among links in paths of length greater than 2.While in the best case BRACER achieves more than 180% improvement over the link-based approach, even in the worst case BRACER performs marginally (35%) better than the link-based and the flow-based approach.

VII. CONCLUSION

A fully-distributed broadcast protocol named BRACERprotocolcan provide very high successful broadcast ratio. Using cross-layer optimization technique which is used to design the far away secondary users will also get involved into channel work.It will increase the channel throughput. It can reduce the time delay.

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