IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

Survey on Various Routing Approaches for Efficient Multimedia Transmission in CRSN

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Abstract: Cognitive radio (CR) is a technology used for wireless networks to solve the problem of spectrum underutilization. It can be achieve by opportunistically exploiting portions of the spectrum temporarily by vacating licensed primary users. In this paper, we make a survey of traditional and recent routing protocols used for successful multimedia routing in Cognitive Radio Networks (CRNs). First we focus on how CRNs are different from other wireless networks and then list out the number of challenges and main issues of routing in Cognitive Radio Networks (CRNs). We then present different routing protocols that are specially designed for CRNs. The main aim in designing the routing protocols for the cognitive radio networks is the combine design of routing and spectrum management. Works on such issues have just started and are still in a progressing stage.

Keywords: CRSN, multimedia routing, routing protocol, spectrum, cross layer routing.

I. INTRODUCTION

The need of cognitive radio sensor networks (CRSNs) is arises for efficient spectrum utilization. The two major facts of this area are the underutilization of the spectrum below 3 GHz and the congestion problem in both licensed and unlicensed bands.

Meanwhile, as the World gradually develops into an Internet of Things, the ubiquity of wireless sensor networks (WSNs) is accordingly becoming imperative. There is a problem of spectrum utilization problem in WSNs. The concept of CRSN is helpful to address this spectrum utilization challenge. The CRSN is a distributed network of wireless cognitive radio sensor nodes that senses an event signal. It can collaboratively communicate readings dynamically in available spectrum bands in a multi-hop manner. It satisfies application-specific requirements. The problem of spectrum utilization is solve by temporary usage of vacant primary user (PU) spectra using dynamic spectrum access (DSA) but there is a condition that the user will leave that spectrum once the presence of the incumbent is detected.

Cognitive radio (CR) technology has been proposed as a promising solution to address the increasing congestion in the unlicensed band by using the vacant spectrum of licensed band opportunistically while avoiding disruptions to the legacy users, such as, TV broadcast stations, public safety broadcast stations, wireless microphones, etc. The CR user or secondary user (SU) is allowed to use only locally unused spectrum opportunistically; so that it does not cause any interferences or collisions to the incumbent or primary users (PUs). When CR users detect the presence of PU on the operating band, they must switch to other spectrum band.

Main Features of a CRSN is that, it adopts the intrinsic characteristics of WSNs to gain any rational meaning, but still performing CR functions. The nature of throughput is expected to be burst due to opportunistic channel usage. It reduces the problem of an increased probability of collision in densely deployed WSN environments. Because of the low throughput in traditional WSNs, congestion and over-flooding are not significant design issues. However, with the burst nature of throughput in CRSNs, these issues must be addressed, especially in real-time applications that consider quality of service (QoS).

Recent Research Trends in CRSNs focused on different cognitive approaches. Most of the researchers working on DSA approaches that are usually restricted to the MAC. Some researchers analyzing the effect of employing common WSN transport layer protocols in a CRSN environment. This gap becomes the need of developing effective CRSN routing protocols for research.

The multi-hop cognitive radio networks having some challenging problems of routing in utilizing multiple channels like traditional multi-channel networks. In this network the set of channels available for each node are not static. A unique challenge is the route selection and the spectrum decision. The spectrum information is required when route is selected because of spectrum bands are dynamically changing. To accept this variation, routing in multi-hop CRNs must be spectrum aware. Second challenging task is the lacks of a fixed common control channel (CCC). Because of a Cognitive radio user has to vacate the spectrum band as soon as a PU begins to use the network, the implementation of a fixed CCC becomes infeasible for CRNs. Thirdly, the spectrum-adaptive route recovery process. In addition to node mobility, link failure in multi-hop CRNs may happen when PU activities are detected. How to vacate the current spectrum band and to move to another available spectrum band quickly is still an unexplored problem. Fourthly, the evaluation metrics for routing with channel assignment are still open issues. This makes how to deal with channel switching is a debatable question. Finally, the route maintenance/reparation; the sudden appearance of a PU in a given location may render a given channel unusable in a given area, thus resulting in unpredictable route failures, which may require frequent

path rerouting either in terms of nodes or used channels. In this scenario, effective signaling procedures are required to restore ‘‘broken” paths with minimal effect on the perceived quality to the best of our knowledge, specific attention has not been given to routing in the network layer of CRSNs, although recent research has emphasized the transport, MAC and physical layers. Hence, there is the need for research to focus on this area. We present a review routing strategies in CRSN requirements to evaluate the strengths and weaknesses of each strategy. This paper presents the various routing strategies and discussing the factors affecting routing in CRSNs.

II. RELATED WORK

Christian et al. presents energy and cognitive radio aware routing (ECR) [1], which is a routing protocol designed for CRSNs. It adopts the same hierarchical network architectures, which can coordinate the clustering operations and the route search algorithm. The implementation of cluster formation is impossible in ECR. In route request phase, the route request (RREQ) packet is sent as a broadcast towards the sink through a common control channel. Intermediate nodes forward the RREQ. Route maintenance is only performed locally if the affected node is in close proximity to the sink. Otherwise, a message must be sent back to the source to initiate a new route request, which can be costly.

The spectrum-aware cluster based energy efficient multimedia (SCEEM) routing protocol for CRSNs [2], which can support the quality of service (QoS) and energy-efficient routing by limiting the participating nodes in route establishment. The proposed protocol in the literature is thus a cross layer routing protocol and only suitable for wireless multimedia sensor networks (WMSNs) application scenario, which comprised of sensor devices equipped with audio and visual information collection modules, can have the ability to retrieve multimedia data, store or process data in real-time, correlate and fuse multimedia data originated from heterogeneous sources, and wirelessly transmit collected data to desired destinations.

The virtual cluster-based reliable opportunistic routing (ROR) approach for routing in CRSN is proposed in [3]. It is like all on-demand routing protocols, where a path is only sought when it is required, and the same is maintained to the end of the transmission process. This protocol provides a very robust routing framework that fuses a reactive geographical forwarding scheme into AODV to create a robust scheme that considers the link quality of communicating nodes for data forwarding in ROR, all control signaling is done through CC and the route request phase is used to search for all possible routes from the source node to the sink. The sink selects the best route that offers certain quality of service (QoS) guarantee levels, basically based on bandwidth and delay.

The low-energy adaptive uneven clustering hierarchy (LEAUCH) is proposed in [4] for CRSN. It can not only consider the advantage of channel resources brought by cognitive function in CRSN but also exploit the uneven clustering method based on the channel resources. More specially, in the proposed algorithm, the number of idle channels of each node is taken as its weight and the nodes with more idle channels are elected as candidate cluster head (CH) nodes. Based on the idea of the uneven clustering method, there are fewer members in the clusters near the sink. In this way, the energy of CHs near sink can be saved, and further more energy can be used for forwarding data, which can balance energy consumption among CHs under multiple hops transmission means in CRSN.

The literature [5] proposed a cognitive LEACH (CogLEACH) for CRSN that uses the number of vacant channels as a weight in the probability of each node to become a CH and that can prolong the network lifetime compared with LEACH algorithm. However, the algorithm does not consider the balance of energy consumption among CHs under multiple hops transmission means, which may lead to the premature death of the nodes near the sink because of their excessive energy consumption.

The literature [6] proposed an event-driven clustering algorithm. The qualified nodes are determined based on the distance from sensor nodes to the event occurrence point and the sink. CHs are selected among the qualified nodes according to node degree, available channels, and the distance to the sink in their neighborhood. The clusters in the scenario are immediately dismissed after finishing data transmission, and all nodes enter the sleeping state again in order to save the energy. Therefore, the proposed algorithm in the literature is only confined to event-driven CRSN, which cannot be suitable for other scenarios such as the time-triggered CRSN scenario.

Zhou et al. [7] propose a distributed scheduling algorithm (DMDS) for video streaming over multichannel multi radio devices in wireless networks, aiming to preserve the QoS for each individual stream. DMDS does not employ a CR for dynamic spectrum access and assumes that the set of given channels are always available to the nodes, i.e., fixed channels. Second, the nodes employ a single radio in this paper, whereas DMDS assumes multiple interfaces on a single node and schedules them accordingly. In contrast, this paper implements dynamic spectrum utilization, which is achieved by CR through dynamic spectrum management, functions. Moreover, a single radio device will be cheap and energy efficient for low-cost and low-power multimedia devices in sensor networks. Third, the routing protocol in DMDS does not incorporate the energy metric in its routing decision and is therefore unsuitable for low-power devices.

Yu et al. [8] propose application-layer QoS optimization for multimedia transmission over CRNs in which SUs adopt their interframe refreshing rate based on the sensed channel conditions. The proposed work is a joint source and physical layer solution that does not incorporate the network support for QoS constrained multimedia delivery. Multimedia transmission over CRNs is also investigated in [9], which uses priority queues to model both the PU traffic and the SU traffic.

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II. PROPOSED SYSTEM

The lack of established infrastructure, network dynamics, and constrained spectrum access privileges, along with the unpredictable band opportunity and the nature of the wireless medium, offer an unprecedented set of challenges in supporting demanding applications over CRSNs. Thus, supporting demanding applications are characterized as delay sensitive wireless multimedia sensor networks over CRSNs presents many key issues, which are not dealt with in its counterpart WMSN. Multimedia applications are characterized as delay sensitive and high bandwidth stipulating traffic sources. Supporting such demanding applications on cognitive radio sensor networks with energy and spectrum constraints is a highly daunting task. That's why this paper propose a spectrum aware clustering based energy efficient multimedia (SCEEM) routing protocol for CRSNs that jointly overcomes the formidable limitations of energy and spectrum. This system having multiple clusters with cell edge cluster members and cell centers cluster members also a cluster head. Cell edge members are far away from cluster head whereas cell center members are near to cell head. All these clusters are communicated through base station that is shares multimedia data through base station. For this communication frequency is allocated by cluster head to cluster members one by one. But there is a problem of equivalent frequency distribution within multiple members. Cell center members are near to cluster head therefore they have immediate resource allocation but where same case is not happen with cell edge center because of large distance. This is result into more waiting time for resource allocation to the cell edge members. This problem is overcome by our proposed system. The main aim of this system is that, to provide equal resource allocation within all cluster members to achieve the routing. This optimal clustering provides energy-efficient multimedia delivery with the desired QoS support also Reduce delay with a higher delivery ratio.

TABLE 1: SURVEY TABLE

S.No	Paper	Technique	Advantage	Disadvantage	Result
1	Energy-and cognitive-radio-aware routing in cognitive radio sensor networks [1]	energy- and cognitive-radio-aware routing (ECR)	network is highly prone to experiencing multiple new route requests	channel availability metric was not properly accounted	coordinates the clustering operation, and the route search algorithm to the sink adopts similar principles
2	A Spectrum-Aware Clustering for Efficient Multimedia Routing in Cognitive Radio Sensor Networks [2]	SCEEM-hierarchical routing scheme	organizes neighboring nodes into clusters after the sharing of local spectrum sensing results and residual energy	Cannot maximizes the utilization of idle listening	efficient energy consumption and dynamic spectrum access
3	Reliable Geographical Forwarding in Cognitive Radio Sensor Networks Using Virtual Clusters. [3]	ROR-geographical routing scheme	maximizes the utilization of idle listening	Cannot able to avoid the creation of routing hot spots in the network by its decentralized forwarding technique	utilizes clustering to ensure the instantaneous link quality guarantee and route stability in order to maintain QoS
4.	LEAUCH: low-energy adaptive uneven clustering hierarchy for cognitive radio sensor network[4]	LEAUCH-uneven Clustering approach	channel resource in reducing the energy consumption	Can not applicable for more complicated network topology	best performance in terms of network lifetime, the energy consumption and network load balance hops transmission means
5.	CogLEACH: a spectrum aware clustering protocol for cognitive radio sensor networks. [5]	cognitive LEACH protocol	uses the number of vacant channels as a weight in the probability of each node	does not consider the balance of energy consumption among CHs under multiple hops transmission means	prolong the network lifetime compared

III. ARCHITECTURAL VIEW

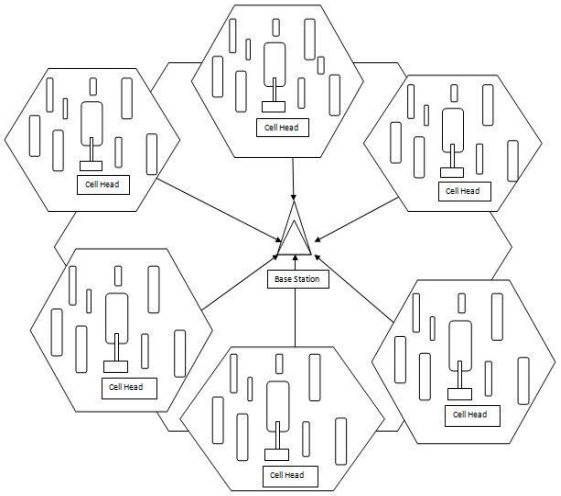

Fig1. Architectural View

IV. CONCLUSION

Since available spectrum bands in CRNs with multi-hop communication are different for each hop, spectrum sensing information is required for topology configuration in CRNs.

Moreover, a major design choice for routing in CRNs is the collaboration between routing and spectrum decision. In this survey, important properties and current research challenges of the routing protocols for CRNs are presented. We investigate the unique challenges in routing protocols of CRNs. From literature survey we conclude that there is a need of further research in the field of CRNs routing. The research should be focused on network dynamics and variability properties, which are attractive features of the multi-hop CRNs.

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