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# A Study of Routing Protocol For Cognitive Radio Sensor Networks

Deepika Patel<sup>1</sup>, Prof. Nitesh Kumar<sup>2</sup>, Prof. Keshav Mishra<sup>3</sup>

M.Tech Scholar, Department of Electronics and Communication, Sagar Institute of Research Technology & Science,  
Bhopal, India<sup>1</sup>

Assistant Professor, Department of Electronics and Communication, Sagar Institute of Research Technology &  
Science, Bhopal, India<sup>2</sup>

Associate Professor, Department of Electronics and Communication, Sagar Institute of Research Technology &  
Science, Bhopal, India<sup>3</sup>

**ABSTRACT:** Wireless Sensor Networks (WSNs) have been increasingly considered an attractive solution for a advance communication applications. The low cost of sensor nodes provides a mean to deploy large sensor arrays in a variety of applications such as civilian and environmental monitoring. Most of the WSNs operate in unlicensed spectrum bands which have become overcrowded. As the number of the nodes that join the network increases the need for energy-efficient, resource-constrained and spectrum-efficient protocol also increases. Incorporating cognitive radio capability in sensor networks yields a promising networking paradigm, also known as Cognitive Radio Sensor Networks (CRSNs). In this paper, a routing protocol for cognitive radio network is presents which are to improve the network performance after increasing network scalability.

**KEYWORDS:** Cognitive radio, routing, protocol, sensor, power, wireless.

### I. INTRODUCTION

Due to the highly dynamic nature of cognitive vehicular networks, several sporadic links induce a long delay in the network. The selection of a stable route is therefore one of the key design factors to improve overall network stability, thereby reducing the end-to-end delay. Software-defined networking (SDN) is a novel approach that improves network intelligence. The concept of a smart city is used globally with various definitions and nomenclatures. In most of the cases, the terminology is generally coined to represent the advancements in urban technology through systems integration. As per the United Nations statistics, it is estimated that by year 2050, around 68% of the world population would be living in urban areas .This situation would invariably result in the challenges of urbanization, which include (and are not limited to) waste management, air pollution, traffic management, human health and disaster management — an area under active research of late. Although there is an increased concern worldwide regarding the performance enhancement of networks while also keeping an eye on the rural-urban digital divide due to technological advancements in urban areas, however, the search for innovative solutions to ensure more efficient urban dynamics for conservation of resources and optimal use of technology is still a work in progress. The core of infrastructure in smart cities is sensing. The appropriate use of effective sensors with ubiquitous range and efficient communication is the need of the hour to ensure optimal resource utilization. Such an approach can only yield fruitful results when the number of sensors is significantly high and are mutually connected to each other for exchange of information. This calls for the formulation of a communication infrastructure and a mechanism for data aggregation and processing. Therefore, various approach e s which may be considered in case of such an infrastructure are Internet of Things, Cloud of Things and Wireless Sensor Networks (WSNs).

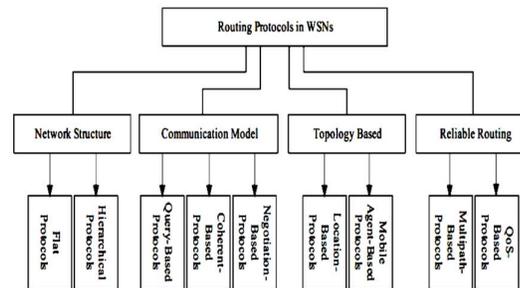


Figure 1: Classification of WSN routing protocols

In this work, it is propose and investigate an efficient multichannel Medium Access Control (MAC) protocol for Cognitive Radio Ad Hoc Networks (CRAHNs). Cognitive Radio (CR) is one of the it is ll developed technologies extensively used for raising the spectrum performance for constructing opportunistic transmission links. Sustaining to the routing function on top of opportunistic links is a mandatory for transporting packets in a CR Ad hoc Network (CRAHN) holding the cooperative relay multi-radio systems. However, there is insufficient understanding of these highly dynamic opportunistic links, bandwidth, throughput, Link duration, Spectrum propagation and a reliable end-to-end transportation mechanism over the CRAHN.

## II. RELATED WORK

**K. Moyaba et al., [1]** Cognitive Radio (CR) is an enabling technology, which allows CR users to exploit the spectrum allocated to Primary Users (PUs) in an opportunistic manner due to the spectrum scarcity challenges. However, Quality of Service (QoS) is a challenge in CR networks. A few studies have considered QoS in CR networks. Most researchers have concentrated on the protection of PUs due to the high priority they have. it is consider the problem of scheduling available multiple channels to the CR users when they are free. For this reason, it is propose a Cross Layer Design (CLD) scheme which jointly considers Media Access Control (MAC) and Network Layer as one optimisation problem. Specifically, it is consider the joint dynamic spectrum allocation, scheduling, routing, and transmit power control. Our scheme aims at reducing end-to-end delay, latency, interferences, and maximizing the network throughput. The performance evaluation of our scheme was conducted using the Network Simulator 2 (NS2) and compared to other CRAHN cross layer protocols. The results show that our scheme outperforms other cross layer protocols.

**H. Ghafoor et al., [2]** To this end, it is propose a novel SDN-based routing protocol for cognitive vehicular networks that finds a stable route between source and destination. As this is a cognitive routing protocol, spectrum sensing is therefore the primary task of this algorithm to improve network stability by keeping primary user activity safe. it is apply a belief propagation algorithm for channel selection. This is an SDN-based vehicular communications scheme where two nodes can only communicate when they have consensus about a common idle channel. The protocol has two phases: the registering phase and the route prediction phase. The SDN main controller (MC) is responsible for a global view of the network, whereas several local controllers (LCs) are responsible for localized global views of the network. This layering of controllers into two kinds (MC and LCs) improves the network performance in terms of end-to-end delay, high delivery ratio, and low overhead. it is prove this in our simulation results by comparing our proposed scheme with two existing schemes (one with, and another without, SDN).

**H. M. A. Abdullah et al., [3]** To elucidate these problems two Spectrum Map Opportunistic Routing (SMOR) algorithms such as SMOR-1 and SMOR-2 are proposed for regular and large-scale CRAHNs with wireless fading channels. However satisfying the network bandwidth, delivery ratio and the analysis to deal with transmission delay over such opportunistic links becomes important aspect. In order the solve the case and meet above stated limitations Hybrid Firefly Simulated Annealing based Spectrum Opportunistic Routing Algorithm(HFSA-SORA) is projected to

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the concerning of the spectrum map from local and global spectrum sensing information. A key beneficence of this HFSA-SORA is to the map the above mentioned metrics, and local Primary User (PU) interference observations in the direction of a packet forwarding delay over the opportunistic links. This permits the multipath formation undertaken over a large-scale CRAHNS to grasp the environmental and spectrum information for all the intermediate nodes, thereby degrading the computational overhead at the endpoint. From the theoretical derivations, propose HFSA-SORA for regular and large-scale CRAHNS with wireless fading channels, employing a cooperative networking scheme to enable multipath transmissions. Simulations substantiate that HFSA-SORA solutions enjoy significant breakage of end-to-end delay, reduction of network bandwidth, and minimum packet loss, attain a higher throughput and lesser co...

**K. Priyanka et al., [4]** Wireless spread spectrum is a standout amongst the most valuable assets. With the fast development of the quantity of remote gadgets, interchanges over the unlicensed range groups get to be extremely swarmed. Data dissemination in the wireless environment is usually characterized as the spreading of data to numerous goals through communicating. The principle target is to achieve the most extreme number of neighbors with each sent parcel. The main objective of the 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. Wireless mesh nodes utilize the cognitive radio to share the spectrum with primary users. Depending on the primary user's activities, the spectrum resources available to the cognitive mesh nodes are varying in both space and time. In this joint design scheme can accommodate the traffic load, or achieve half the delay compared to the disjoint methods.

**A. Sofwan et al., [5]** The proposed protocol supports Secondary Users' (SUs) dynamic utilization of the licensed channel of Primary Users (PUs) to enable the SUs' performance of a multichannel data transmission simultaneously and without interfering with each other. The proposed protocol can be cooperative or non-cooperative. The cooperative protocol scheme enables a SU to sense PU's presence independently in a multichannel architecture and then broadcasts the report to its neighbors in a proactive fashion. The performance of the cooperative and non-cooperative protocol schemes is simulated and compared. The performance demonstration focuses not only on the SU performance but also on the PU's performance with an Ad hoc On-demand Distance Vector (AODV) routing protocol. The simulation results show that the proposed protocol enhances the network utilizations in general and that the cooperative scheme significantly enhances the Packet Delivery Ratio (PDR) and decreases the end-to-end delay of SUs with high traffic PU connections.

**M. Tran et al., [6]** In this work, an energy-aware routing algorithm based on renewal process is proposed to choose highly competitive solutions for routing performance in cognitive radio ad hoc networks (CRANs). Moreover, it is propose a new medium access scheme through spectrum forecast for secondary users to access the primary users' channels. Thereby, the proposed algorithm can allow selected routes corresponding to minimum energy possible between source and destination nodes in cognitive radio networks. The contribution of thiswork is achieved through energy utilized in the network. Simulation results show that energy consumption, system throughput and end-to-end delay can be optimized by using proposed algorithms.

**R. Moazzez-Estanjini et al., [7]** Message ferrying has been shown to be an effective approach to support routing in sparse ad hoc or sensor networks. Considering a generic network model where each node in the network wishes to send data to some (or possibly all) other nodes with known (and possibly different) rates, it is propose three schemes enabling multiple ferries to coordinate in collecting and delivering the data. it is analyze the performance of each scheme and establish bounds on the average and worst-case delay. The latter bounds are useful in offering performance guarantees. it is establish that under one of our schemes, constant per-node throughput is achievable within constant maximum (worst-case) delay as the network size grows. Using simulation, it is compare our proposed schemes with an alternative, the Ferry Relaying algorithm proposed earlier in the literature. The results show that our schemes perform better and provide guidance on which scheme to use given performance preferences and the number of available ferries.

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**S. Parvin et al., [8]** In multi-hop wireless mesh network (WMN), hidden node is one of the major problems when IEEE 802.11 DCF is used as a MAC protocol. It causes data packet collisions between the multi-hop links and significantly affects the network performance. In order to avoid this problem, a novel routing scheme is proposed in this paper. It uses a high sensitive sensing function utilized for cognitive radio. The purpose of this sensing function is used to detect the existence of the hidden node. This function is considered to construct a route from the source node to the destination node. In the proposed method, high sensitive sensing device is utilized in both route selection and in the MAC protocol. Throughput and delay are used for evaluation criteria. From the computer simulation it confirms that the proposed routing scheme will improve the throughput and the delay performance with a suitable sensing level comparing to the conventional systems.

Table 1: Summary of literature survey

Sr No.	Author Name & Year	Proposed Work	Outcome
1	K. Moyaba, IEEE 2018	A Cross Layer Design scheme which jointly considers Media Access Control and Network Layer as one optimisation problem.	The results show that our scheme outperforms other cross layer protocols.
2	H. Ghafoor, IEEE 2018	A novel SDN-based routing protocol for cognitive vehicular networks that finds a stable route between source and destination.	Comparing our proposed scheme with two existing schemes (one with, and another without, SDN).
3	H. M. A. Abdullah, IEEE 2017	To Elucidate these problems two SMOR algorithms such as SMOR-1 and SMOR-2 for regular and large-scale CRAHNS with wireless fading channels.	That HFSA-SORA solutions enjoy significant breakage of end-to-end delay, reduction of network bandwidth,
4	K. Priyanka, IEEE 2017	The main objective of routing and resource allocation strategies in order to minimize the average end-to-end delay of multiple data connections.	In this joint design scheme can accommodate the traffic load, or achieve half the delay compared to the disjoint methods
5	A. Sofwan, IEEE 2015	Investigate an efficient multichannel MAC protocol for Cognitive Radio Ad Hoc Networks.	The network utilizations in general and that the cooperative scheme significantly enhances the PDR and decreases.
6	M. Tran, IEEE 2014	Algorithm can allow selected routes corresponding to minimum energy and destination nodes in cognitive radio networks.	Energy consumption, system throughput and end-to-end delay can be optimized by using.
7	R. Moazzez-Estanjini, IEEE 2010	Three schemes enabling multiple ferries to coordinate in collecting and delivering the data. it is analyze.	Provide guidance on which scheme to use given and the number of available ferries.
8	S. Parvin, IEEE 2010	A high sensitive sensing function utilized for cognitive radio. sensing function is used to detect the existence of the hidden node.	The delay performance with a suitable sensing level comparing to the conventional systems.

### III. CHALLENGES AND APPLICATIONS

#### A. Challenges

CR-WSNs differ from conventional WSNs in many aspects. Because protecting the right of PUs is the main concern in CR-WSN, it has many new challenges including the challenges in the conventional WSNs. This section shows the challenges affecting the design of a CR-WSN. CR-WSN is a new paradigm in a WS network arena that utilizes the spectrum resource efficiently for bursty traffic. The system has the capability of packet loss reduction, power waste reduction, high degree of buffer management, and has better communication quality. This section discusses the advantages of using cognitive radio in WSNs.

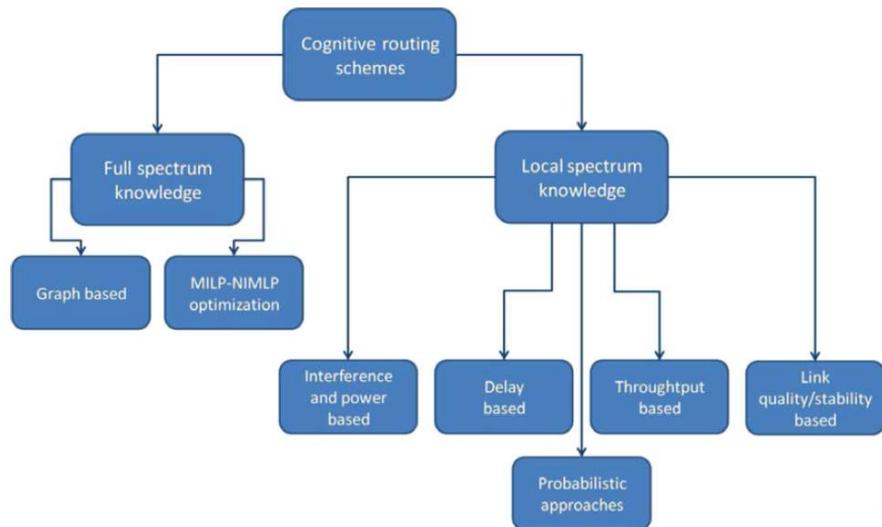


Figure 1: Cognitive routing scheme [13]

Challenge 1: the spectrum-awareness; designing efficient routing solutions for multi-hop 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: the set up of “quality” routes in dynamic variable environment; the very same concept of “route quality” is to be re-defined under CRN scenario. Indeed, the actual topology of multi-hop CRNs is highly influenced by PUs’ behavior, and classical ways of measuring/assessing the quality of end-to-end routes (nominal bandwidth, throughput, delay, energy efficiency and fairness) should be coupled with novel measures on path stability,

Challenge 3: the route maintenance/repairation; 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 signalling procedures are required to restore “broken” paths with minimal effect on the perceived quality. [13]

#### B. Applications

Currently, the number of wireless sensors deployed for different applications has increased. In WSN, data traffic is usually correlated both temporally and spatially. When any event occurs, WSNs generate packet bursts and they remain silent when there is no event. These temporal and spatial correlations introduce to the design challenge of the communication protocols for WSN. With the intelligent communication protocols in CR-WSN, it is possible that the

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wireless sensors deployed for the same purpose use the spectrum of different incumbents in spatially overlapping regions. This is possible with cooperative communication among SUs, which obviously mitigates interference issues.

## IV. CONCLUSION

As a successful technology to serve in urban areas, wireless sensor networks still have a lot of ground to cover because energy constrained sensors with compromised processing ability need to effectively operate in diverse environment of multiple applications. To use small, lightweight and portable sensors for multitasking, we need appropriate protocols which enable sensors to work properly by avoiding overkill so that energy levels of sensor nodes are not depleted. Therefore, we opine that efficient operation may be achieved by rendering some of the sensor nodes for data aggregation in one situation, whereas another scenario would call for a few nodes to act as data relays instead of aggregators. Similarly, the selection of routing protocols would vary depending upon whether the intended operation is location assisted or mobility based. We have discussed routing protocols in this paper which may serve as a selection guideline in terms of their operational mechanism and utility.

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