RESEARCH ARTICLE OPEN ACCESS

Efficient Path Selection Using Enhanced Channel Assignment Algorithm (ECAA) in Multi Hop Wireless Sensor Network

[1]Anitha Ganesan, [2]S. George Joseph Edison, [3]D. C. Joy Winnie Wise, [4]Gopala Krishnan

Department of CSE, Francis Xavier Engineering College, Tirunelveli, Tamilnadu, India

Abstract:

The large development of wireless services and the scarcity of usable frequencies require an efficient use of the Wireless Sensor Network which guarantees interference avoidance. The Channel Assignment Problem (CAP) achieves this goal by partitioning the radio spectrum into disjoint channels, and assigning channels to the network base stations so as to avoid interference. Modified Regret Matching procedure meets the requirements of channel assignment for WSNs: low overhead and decentralization. The proposed system deals with the path selection problem in multi-hop WSN such as under-flow routing, link scheduling and WSN source's budget constraints. A new service provider, called Secondary Service Provider is introduced, to help WSN sessions to select the path for packet delivery. A channel for each link is selected along the path by considering the two factors: 1. channel is not already assigned within one hop neighbor, 2. channel with minimum susceptibility among the common channel set of link. The proposed system is designed to utilize the wireless sensor network more efficiently, and to maintain the most efficient form of communication without interference and mobility model.

Keywords — **Wireless Sensor Network, Broadcast, Secondary Service Provider.**

I. INTRODUCTION

Wireless technology has expanded the limits of our world. Through this innovation, people have been given freedom to work away from their desks or even outside. The newfound freedom that people are beginning to enjoy with their computers has started making the world of technology and nature blend. Wireless Sensor Networks are the next stage of this technology-nature cohesion. Although a young technology, the applications have been varied and promise to be even more varied. These networks are collections of small devices, known as motes, with limited computational power. Each mote has approximately 1-100th of the computing power of a PDA, but when combined with hundreds of other motes, they combine to form an extremely capable system. Wireless Sensor Networks, or WSNs, have been used to enable better data collection in scientific studies, create more effective strategic military defenses, pinpoint the origin of a gunshot, and monitor factory machinery [Culler, 2004]. All of these uses depend on the ability to collect data such as light, vibration, moisture, temperature, and more, as well as the ability to communicate with each other. The introduction of these collections of computing devices has brought forth changes in factory safety, machine maintenance, data collection, and military effectiveness.

II. RELATED WORKS

In [3] Alexandros G. Fragkiadakis, Elias Z. Tragos, Sherali Zeadally, and Vasilios A. Siris studied about Cognitive radio (CR) that has emerged as a promising technology to exploit the unused portions of spectrum in an opportunistic manner. The fixed spectrum allocation of governmental agencies results in unused portions of spectrum, which are called “spectrum holes” or “white spaces”. CR technology overcomes this issue, allowing devices to sense the spectrum for unused portions and use the most suitable ones, according to some pre-defined criteria. Spectrum assignment is a key mechanism that limits the interference between CR devices and licensed users, enabling a more efficient usage of the wireless spectrum. Interference is a key factor that limits the performance in wireless networks. The scope of this work is to give an overview of the problem of spectrum assignment in cognitive radio networks, presenting the state-of-the-art proposals that have appeared in the literature, analyzing the criteria for selecting the most suitable portion of the spectrum and showing the most common approaches and techniques used to solve the spectrum assignment problem. Finally, an analysis of the techniques and approaches is presented, discussing also the open issues for future research in this area.

In [4] Allen B. MacKenzie, Luiz A. DaSilva, and Ryan E. Irwin uncovered the advancement of cognitive radio (CR) that has new dynamics in multi-hop, wireless networking. Given the increased agility of a transceiver’s frequency assignment, the network topology can be optimized to address end-to-end networking goals. In this work, a channel assignment scheme for cognitive radio networks (CRNs) is proposed, that balances the need for topology adaptation focusing on flow rate maximization and the need for a stable baseline topology that supports network connectivity. It focuses on CRNs in which nodes are equipped with multiple radios or transceivers, each of which can be assigned to a channel. First approach is assigning channels independently of traffic, to achieve basic network connectivity and support light loads such as control traffic, and second, it dynamically assigns channels to the remaining transceivers in response to traffic demand. This paper, focuses on the traffic independent (TI) channel assignment with the goal of dedicating as few transceivers as possible to achieving baseline connectivity. By conserving transceivers in the TI assignment, the network is more able to adapt to any traffic demands in a subsequent traffic-driven (TD) assignment. The problem is formulated as a two-stage mixed integer linear program (MILP), with a TI stage and a TD stage. It proposes a centralized greedy approach to TI assignment which performs nearly identically to the optimum obtained from the two-stage MILP in terms of the number of transceivers assigned and flow rate in the evaluated scenarios. Subsequently, it proposes a distributed greedy TI approach that performs within 9% of the optimum in terms of the number of transceivers assigned and within 1.5% of the optimum in terms of flow rate.

In [5] Ben Leong, Manjunath Doddavenkatappa, Mun Choon Chan discovered that a large percentage of links in low-power wireless sensor networks are of intermediate quality. Opportunistic exploitation is currently the only way to use these links. However, such exploitation requires overhearing which consumes a significant amount of energy. In this paper, we propose a new approach to exploit intermediate quality (IQ) links through channel diversity with a new protocol, called IQ Link Transformation Protocol (ILTP), which does not require overhearing. ILTP transforms IQ links into good links thus allowing us to exploit such links continuously rather than using them only opportunistically. The key insight is that the packet reception ratios (PRR) across different channels on IQ links are not correlated and it is common on such links to find channels that change in quality on the time scale of a few minutes. Consequently, when the link quality of a channel is bad, it is highly likely that a good channel can be found and its quality will remain good for at least a few minutes. The evaluations on three large-scale test-beds demonstrate that ILTP is able to consistently transform the IQ links into good links. It is observed that even a poor link with a PRR of 0.05 can be transformed into a good link with a PRR greater than 0.9. When ILTP is integrated with CTP, the default collection tree protocol for TinyOS, the average number of transmissions per end-to-end packet delivery is reduced by 24% to 58%.

In [13] Jiming Chen, Peng Cheng, Qing Yu, Yanfei Fan, Youxian Sun, and Xuemin Shen formulated a multi-channel allocation in wireless sensor and actuator networks as an optimization problem which is NP-hard. In order to efficiently solve this problem, a distributed game based channel allocation (GBCA) Algorithm is proposed by taking into account both network topology and routing information. For both tree/forest routing and non-tree/forest routing scenarios, it is proved that there exists at least one Nash Equilibrium for the problem. Furthermore, the sub-optimality of Nash Equilibrium and the convergence of the Best Response dynamics are also analyzed. Simulation results demonstrate that GBCA significantly reduces the interference and dramatically improves the network performance in terms of delivery ratio, throughput, channel access delay, and energy consumption.

In [14] Kanthakumar Pongaliur, Li Xiao, and Yong Ding have devoted many efforts in maximizing network throughput of a multichannel multi-radio wireless mesh network. Most current solutions are based on either purely static or purely dynamic channel allocation approaches. In this paper, a hybrid multichannel multi-radio wireless mesh networking architecture is proposed, where each mesh node has both static and dynamic interfaces. It first presents an Adaptive Dynamic Channel Allocation protocol (ADCA), which considers optimization for both throughput and delay in the channel assignment. In addition, an Interference and Congestion Aware Routing protocol (ICAR) is also proposed in the hybrid network with both static and dynamic links, which balances the channel usage in the network. The simulation results show that compared to previous works, ADCA reduces the packet delay considerably without degrading the network throughput. The hybrid architecture shows much better adaptivity to changing traffic than purely static architecture without dramatic increase in overhead, and achieves lower delay than existing approaches for hybrid networks.

In the existing work, the channel assignment problem in WSNs is modeled as a game, and makes each player perform a Modified Regret Matching procedure (MRM) according to its own history information. In MRM, each player is highly autonomous, i.e., each player is only required to provide its own environmental information and with a low-level awareness of other players. Hence, MRM meets the requirements of channel assignment for WSNs: low overhead and decentralization. This work proposes an energy efficient multichannel MAC protocol, Y-MAC, for WSN to achieve both high performance and energy efficiency under diverse traffic conditions. MRMCA converges almost surely to the set of correlated equilibrium, in which the action of each sensor node is an optimal response to its environment and to the actions of other sensor nodes so that the whole network achieves a reasonable suboptimal network performance. MRMCA also adapts the channel assignment dynamically to the time-variant transmission flows in the network to reduce interference efficiently. Modified RMCA achieves better network performance in terms of both delivery ratio and packet latency randomized CSMA. The main disadvantages of the existing system are latency and spectrum wastage.

III. ADDRESSSING PATH SELECTION PROBLEM

In the proposed system, the path selection problem in multi-hop wireless sensor network is investigated. A new service provider, called the secondary service provider is introduced, to help WSN sessions to select the paths for packet delivery. The price of bands and the potential returns of the primary services at different WSN links, flow routing and link scheduling under the budget constraints are considered. The SSP helps the sessions to select the paths for packet delivery. In the proposed system is designed to utilize the wireless sensor network more efficiently, and to maintain the most efficient form of communication without interference and mobility model. The main advantages of this system is that it reduces the communication overhead and also improves the network lifetime.

.

Before beginning the communication, the available network is searched. The personal communication information, broadcast and entertainment information are the parameters to be collected and will have to be merged into a seamless pool of content available according to the user's requirement. The user will have access to a wider range of services and applications, with greater convenience and security in a manner of reflecting the user's personal preferences**.** So, the user preference parameters are collected to access communication among each other**.** The best network is chosen according to the rank. The Spearman's Rank Correlation Coefficient is used to assess the relationship between the ranks. It is used to identify and test the strength of the relationship between the two sets of data. It is a statistical method to aid with, either proving or disproving a hypothesis. Here, the network is sorted and selected based on the QoS metrics. (Bit rate, delay, jitter, packet dropping probability and/or bit error rate)

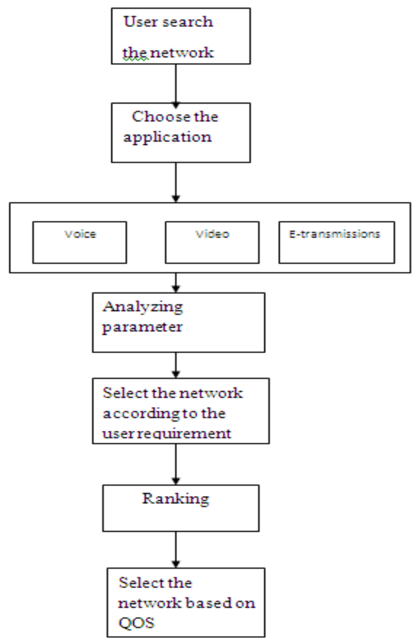

Figure 1 System Design

The system implementation is done in four processes: Topology Creation, Application selection, Path Selection, Channel Assignment.

A. Topology Selection

Topology formation is an important issue in a wireless sensor network. Performance parameters such as energy consumption, network lifetime, data delivery delay, sensor field coverage depend on the network topology. The topology control is one of the research focuses in wireless sensor networks. Different network topologies will have different effects on the properties of the network, such as the reliability, energy consumption and latency. A good network topology has momentous significance for the distribution of network space resources, perception of the environment, information acquisition and the improvement of network viability. Topology formation means that the each node will send their information to the neighbor nodes. The information's are creation time, expiry time, position and also the other details. In this stage we predict the location of each node. Wireless sensor network mainly used for monitoring the events such as disaster tactical in military surveillance. It can be placed in two different manners 1) Regular manner and 2) Irregular manner. Mostly in irregular manner we are deploying sensors in irregularly is the chance for create a holes in sensor networks. Battery depletion is the attack, it drained the energy of sensors. Nodes are used to send the packet and make communication. Then after we construct topology to knows the neighbor information. Each node sends the message to its neighbor to know node details. This topology formation mainly used to find the node location for packet transmission.

.

B. Application Selection

In real time, user can select any type of application like as video calling, voice calling, internet and e-transfer and so on… and in our project we are taking three items video, audio, e-transf. In our project, we included application selection module for setting the specific application with some fixed properties. All the parameter values are normalized so that they take on values in the range of zero and one and also in negative. After getting the rank for given application, the device will select the best network automatically.

C. Path Selection

Path selection is used to achieve highest throughput under multiple constraints. If there is more than one route available for the data delivery from the source node to the destination node, the SSP will select the optimal path on behalf of the source node in terms of the end-to-end throughput. Since the SSP purchases available licensed bands and charges the source node for the WSN session's opportunistic usage of these bands. Even though a candidate path is given, it is too complex for the SSP to find all the independent sets along the path, if the number of links of the path or the number of available licensed bands for selection in WSNs is large. The proposed system implements a heuristic algorithm for path selection with the objective of maximizing the end-to-end throughput for a WSN session. Instead of using independent sets, we classify the edges in the 4D conflict graph into two types, layer the graph by the number of licensed bands, and leverage conflict cliques to find the path with the highest end-to-end throughput for the WSN session under budget constraints.

A heuristic algorithm is one that is designed to solve a problem in a faster and more efficient fashion than traditional methods by sacrificing optimality, accuracy, precision, or completeness for speed. Heuristic algorithms often times used to solve NP-complete problems, a class of decision problems. In these problems, there is no known efficient way to find a solution quickly and accurately although solutions can be verified when given. Heuristics can produce a solution individually or be used to provide a good baseline and are supplemented with optimization algorithms.

D. Channel Assignment

The channel assignment is a challenge in these networks. Several recent proposals had addressed many channel assignment problems in terms of channel conflicts, node mobility etc. However selecting nodes for relaying during the channel assignment need to be addressed for an effective channel assignment and increased throughput in WSNs. New algorithm, called Enhanced Channel Assignment Algorithm (ECAA) is proposed. The new algorithm enables selection of relaying nodes during channel assignment for a Time Division Duplex (TDD) Wideband Code Division Multiple Access (W-CDMA) WSN. These networks allow quick deployment at low cost. Though WSNs have many advantages, they also pose many challenges. The most important of which is improper relaying nodes' selection during channel assignment. This leads to decreased throughput and inefficient channel assignment. Therefore, these need a better and more intelligent channel assignment scheme.

Parameters	Value
BS or mobile range (m)	250m
BS or mobile capacity	345 kbps (or 5 slots/frame and 5 codes/slot)
Antenna	directional antenna with beam angle 45°
Data rate per code	13.8 kbps
Call request rates	0.1 calls/min.
Call holding time	5 min.
Max. hop count	4

ECA Algorithm

Several recent proposals had addressed many channel assignment problems in terms of channel conflicts, node mobility etc. However selecting nodes for relaying during the channel assignment need to be addressed for an effective channel assignment and increased throughput in MCNs.

The ECAA scheme is designed based on two principles, which are summarized as follows.

- Compute the relaying points for a proposed source node in the set of equivalent available paths and choose the best path for channel assignment purpose.

- Find the channels which avoid channel conflicts and also give less relaying delay in the current setup path.

A. Stage - I

During stage *I*, the number of relaying points for each path of the source node path index and channel reservation for each path in the source node path index of the proposed node is determined by computation according to the steps sequence given in the algorithm

1. Input multiple equivalent paths (*1 to N*) where *N* is the last path
2. Input a path *I* (where *I = 1*)
3. The last hop node to the BS : = current node (NDC)
4. Count the number of relaying points (RP) in NDC *and* increase RP index by *1*
5. Reserve a channel (CH) to NDC, Propose a not-tried available CH (T, C), with index of T *is* largest in value

If NDC not receiving on T, *and* If NDs in TZ of NDC not receiving on CH, *then* CH is reserved for NDC, *else* CH is removed and CH reservation fails, *else* All CHs in T are removed and CH reservation fails *endif*

6. NDC: = Nodes next hop (NDN) and successor of NDC: = NDC
7. Count the number of relaying points (RP) in the NDC and add the value in RP index
8. Reserve a channel (CH) to NDN

Propose a not-tried available CH with T nearby to CH of NDN If NDC not receiving on T *and* NDN not transmitting on or assigned with T, *then* If NDs is on other routes with TZ *and* NDN falls, not transmitting on CH, *then* TZ in which NDN falls, not transmitting on this CH *and* NDs in TZ of NDC not receiving on CH, *then* CH is reserved for NDC, *else* CH is removed and CH reservation fails, *endif*, *else* All CHs in T are removed and CH reservation fails *Endif While* CH reservation fails *and* not-tried available CHs exists If CH reservation fails, return **Repeat steps 6,** 7 and 8 until the source node is reached If $I <= N$, *then* Increment I by 1 and continue step 3, *else* Update reserved channel information and RP values in BS table *and* nodes table

9. Select the best path from source node path index
10. Exit the algorithm

B. Stage – II

During the second stage, a best path is chosen for input that have been chosen based on relaying points and further, the reserved channels for that path are assigned to the proposed node connection. The sequence steps for stage II are given,

1. Input a best path that have been chosen based on relaying points computed from stage-I process.
2. Assigned Reserved channels to the selected path of the proposed node
3. Update assigned channels information in BS table and nodes table
4. Exit the algorithm

The ECAA algorithm had offered a better quality of service in the MCNs due to improved channel assignments and reduced channel conflicts.

Heuristic Algorithm

The term **heuristic** is used for **algorithms** which find solutions among all possible one. These **algorithms**, usually find a solution close to the best one and they find it fast and easily.

The path selection heuristics method focuses on different factors, such as path length and global load balancing that can affect the routing performance. By studying these heuristics, we hope to determine which factors are more important and which factors are less critical and to find an efficient way to perform path selection for localized QoS routing. We analyze static measurements of the paths selected by the heuristics and perform extensive simulations to compare the performance of the heuristics. Our main conclusions include the followings. First, path selection methods can greatly affect the performance of localized QoS routing. Second, localized QoS routing with multiple candidate paths between each source destination pair performs better than that with only one path between each source-destination pair. Third, in order for localized QoS routing to be effective, only the paths whose lengths are close to the minimum-hop (between the source and the destination) should be selected as candidate paths. Fourth, global load balancing is an important factor in the path selection process.

This heuristic attempts to find shortest paths between each source-destination pair while minimizing the number of shared links in the candidate paths for a given source-destination pair. This heuristic selects candidate paths for each source destination pair in the following manner. It initially assigns the same weight, 1, to all links in the network and uses the Dijkstra shortest path algorithm to find the first candidate path. After the heuristic finds a candidate path, it increases the weights on all the links along the path and then repeats the process until the number of candidate paths reaches the target or no more new paths can be found. By increasing the weights for the links in the selected paths, the heuristic tends to avoid using the links that are in the selected candidate paths and thus, minimize the number of shared links in the candidate paths.

1. Let S denote the source node, and T denote the destination node;
2. Let Cj= the jth constraint, $0 \leq j \leq (K - 1)$;
3. Let F={ ¯ P| ¯ P is a path from S to T, and ¯ P is determined by Dijkstra algorithm based on K QoS parameters.}
4. Let P □ F, and P contains the longest partial path that satisfies all the constraints;
5. Let a circular queue Q be the tabu list; $k = 0$; L= a small integer;
6. While(k< $ITERATIONS$){
7. Randomly select a partial path R on P where R □ P, $|R| \leq L$;
8. Let $P = P1 + R + P2$ and R is a path from node u to node v;
9. if(R /□ Q){$Q = Q \cup R$; $Cj(R) = Cj - Cj(P1) - Cj(P2)$, $0 \leq j \leq (K - 1)$;}
10. Apply the optimal algorithm to find a new feasible path from u to v; Let ˆR be this new path;
11. if(ˆR satisfies all sub-constraints $Cj(R)$, $\forall j$){
12. Rebuild a new path ˆ P from u to v such that ˆ P = $P1$ + ˆR + $P2$;
13. if(ˆ P is a feasible path){return ˆ P;}
14. else{P = ˆ P;}}
15. $k = k + 1$;}

IV. RESULTS

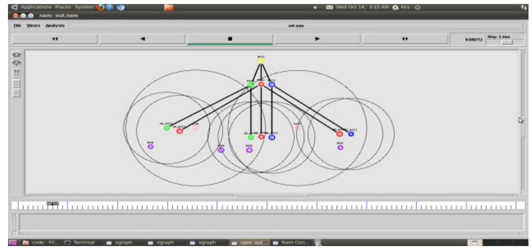

Figure 1 Find Coverage

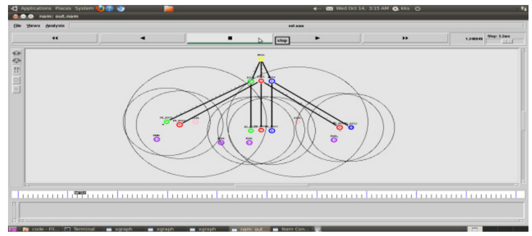

Figure 2 Nodes Communicate

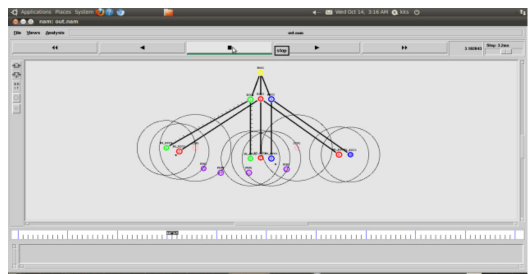

Figure 3 Dynamic Channel Assignment

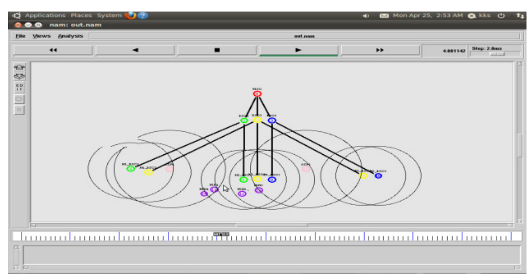

Figure 4 Efficient Path Selection

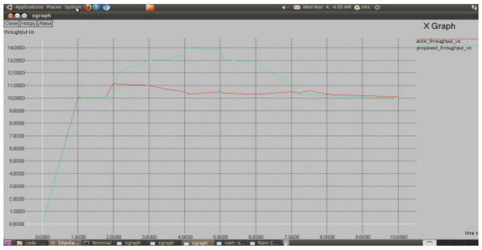

Figure 5 Comparison between Throughput in Existing and Proposed System

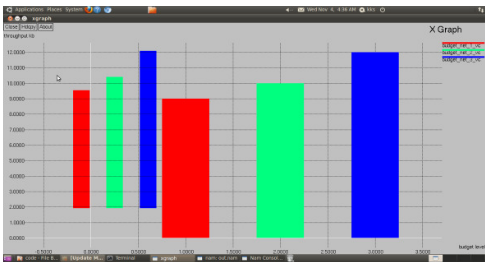

Figure 6 Values for Different Channels

V. CONCLUSION & FUTURE ENHANCEMENT

In the proposed method the QOS performance of the various wireless sensor networks is evaluated and the performance cost at the given locations is composed. A new service provider, called secondary service provider is introduced, to help WSN sessions to select the paths for packet delivery. The user selects the best performance network with low cost. The algorithm selects appropriate network during handoff based on user preferences and interests. The user can opt for multiple QoS parameters like bandwidth, cost of service, security level, call drop probability etc., to select appropriate networks. In a user-centric environment, flexibility and ease-of-access at the user level are essential requirements for the people to adopt the new technology. With the increase in number of quality parameters required by the user, the complexity of the network selection is likely to increase.

In future we will test with more parameters like signal strength, different data rate access. Also path length, global load balancing and shared links, with emphasis on global load balancing, achieves the best routing performance.

VI. REFERENCES

[1] Abdelzaher T. F., Henriksson D., and Le H. K. (2008), 'A practical multichannel media access control protocol for wireless sensor networks', in Proc. Inf. Process. Sensor Netw., St. Louis, Missouri, USA, pp. 70–81.

[2] Ai X., Srinivasan V., and Tham C. K. (2008), 'Optimality and complexity of pure nash equilibria in the coverage game,' IEEE J. Sel. Areas Commun., Vol. 26, No. 7, pp. 1170–1182.

[3] Fragkiadakis A. G., Siris V. A., Tragos E. Z., and Zeadally S. (2013), 'Spectrum assignment in cognitive radio networks: A comprehensive survey,' IEEE Commun. Surveys Tuts., Vol. 15, No. 3, pp. 1108–1135.

[4] DaSilva L. A., Irwin R. E., and MacKenzie A. B. (2013), 'Resource-minimized channel assignment for multi-transceiver cognitive radio networks,' IEEE J. Sel. Areas Commun., Vol. 31, No. 3, pp. 442–450.

[5] Chan M. C., Doddavenkatapp M., and Leong B. (2011), 'Improving link quality by exploiting channel diversity in wireless sensor networks,' in Proc. IEEE Real-Time Syst. Symp., pp. 159–169.

[6] Bi Y., Cai L. X., Liu K. H., Shen X., and Zhao H. (2009), 'A multi-channel

token ring protocol for QoS provisioning in inter-vehicle communications,' IEEE Trans. Wireless Commun., Vol. 8, No. 11, pp. 5621–5631.

[7] Chiueh T., and Raniwala A. (2005), 'Architecture and algorithm for an IEEE 802.11-based multi-channel wireless mesh network,' in Proc. IEEE Int. Conf. Comput. Commun., Miami, Florida, USA, pp. 2223–2234.

[8] Qiao C., Wu F., and Zhong S. (2010), 'Strong-incentive, high-throughput channel assignment for non-cooperative wireless networks,' IEEE Trans. Parallel Distrib. Syst., Vol. 19, No. 12, pp. 1808–1821.

[9] Garcia-Luna-Aceves J.J., and Tang Z. (2000), 'Hop reservation multiple access for multichannel packet radio networks,' Comput. Commun., Vol. 23, No. 10, pp. 877–886.

[10] He T., Lin S., Stankovic J. A., and Wu Y. F. (2008), 'Realistic and efficient multi-channel communications in wireless sensor networks,' in Proc. IEEE 27th Conf. Comput. Commun., Phoenix, AZ, USA, pp. 1193–1201.

[11] Chen J., Fan Y., Shen X., Sun Y., and Yu Q. (2010), 'Multi-channel assignment in wireless sensor networks: A game theoretic approach,' in Proc. 29th IEEE Conf. Inf. Commun., San Diego, CA, USA, pp. 1127–1135.

[12] Chen Q., Fan Y., Shen X., Sun Y., and Yu Q. (2010), 'Regret matching based channel assignment for wireless sensor networks,' in Proc. IEEE Int. Conf. Commun., Cape Town, South Africa, pp. 1–5.

[13] Chen J., Yu Q., Cheng P., Fan Y., Shen X., and Sun Y. (2011), 'Game theoretical approach for channel allocation in wireless sensor and actuator networks,' IEEE Trans. Autom. Control, Vol. 56, No. 10, pp. 2332–2344.

[14] Ding Y., Pongaliur K., and Xiao L. (2013), 'Channel allocation and routing in hybrid multichannel multiradio wireless mesh networks,' IEEE Trans. Mobile Comput., Vol. 12, No. 2, pp. 206–218.

[15] Li X., Song W. Wang W., and Wang Y. (2009), 'Flowbased real-time communication in multi-channel wireless sensor networks,' in Proc. 6th Euro. Conf. Wireless Sensor Netw., Cork, Ireland, pp. 33–52.