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An opportunistic cooperative MAC protocol for cognitive vehicular networks

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Cognitive radio technologies are proposed to increase the utilization of licensed spectrum and to resolve congestion in the industrial, scientific, and medical (ISM) band. A mobile station in a cognitive radio network, called the secondary user, should opportunistically access the licensed channel without interfering the users, called the primary users, who own the absolute access rights of that licensed channel. In this paper, we consider an application scenario in a cognitive vehicular network: The stationary gateways (such as access points) which are scattered on the roadside periodically broadcast data, such as location-dependent travel or safety information, via the ISM band. However, due to multipath fading, shadow fading or other wireless channel characteristics, some vehicles passing through the gateway may successfully receive the broadcast data, while some vehicles may not. Clearly, we hope that the vehicles (called potential relays) that have successfully received the broadcast data can cooperatively relay that data to the vehicles (called potential destinations) that did not received. Thus the problem that we want to study is that under the condition that different vehicles in different locations may have different set of available licensed channels, how do the potential relays choose the proper channel to concurrently relay the data to the potential destinations such that the network throughput can be maximized? We call this problem the interference-free multichannel poly-matching (IMP) problem. To the best of our knowledge, this paper is the first one to seriously address this issue. The contributions of this paper are three-fold: (1) We use the integer mathematical programming to formally model the IMP problem, which is NP-complete; (2) Then we propose a simple centralized greedy algorithm to efficiently derive the near-optimal solutions; (3) Finally, on the basis of the centralized greedy algorithm, we design a novel distributed medium access control protocol, named opportunistic cooperative MAC (OC-MAC for short), such that only via local information exchange between adjacent vehicles, the number of potential destinations that finally receive data from potential relays can be maximized. Simulation results show that the throughput of OC-MAC can be approximately equal to that of centralized greedy algorithm and is greatly higher than that of Random MAC.

Biography

Zi-Tsan Chou received the PhD degree in Computer Science and Information Engineering from National Taiwan University, Taipei, Taiwan, in 2003. He is currently an Associate Professor at the Department of Electrical Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan. His industrial experience includes NEC Research Institute, America, and the Institute for Information Industry, Taiwan. His research interests include medium access control, power management, and quality-of-service control for wireless networks. He is a member of both the IEEE and the IEEE Communications Society.

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Page 54