Accepted Manuscript

A localized algorithm for clustering in cognitive radio networks

Kumar, Awadhesh Kumar Singh

PII: S1319-1578(17)30525-6
DOI: https://doi.org/10.1016/j.jksuci.2018.04.004
Reference: JKSUCI 439

To appear in: *Journal of King Saud University - Computer and Information Sciences*

Received Date: 15 December 2017
Revised Date: 9 March 2018
Accepted Date: 8 April 2018

Please cite this article as: Kumar, Singh, A.K., A localized algorithm for clustering in cognitive radio networks, *Journal of King Saud University - Computer and Information Sciences* (2018), doi: https://doi.org/10.1016/j.jksuci.2018.04.004

A Localized Algorithm for Clustering in Cognitive Radio Networks

Kumar[*], Awadhesh Kumar Singh[#]

National Institute of Technology, Department of Computer Engineering, Kurukshetra, 136119, India
[*]santosh.iet06@gmail.com, [#]aksinreck@rediffmail.com

Abstract— With the steep increase in wireless devices, the requirement of the spectrum has increased for communication. However, despite huge demand, the available spectrum is underutilized. The cognitive radio network (CRN) is more challenging environment as compared to conventional mobile ad hoc network because of node mobility and dynamic channel availability. Therefore, we propose a localized clustering scheme, which aims to provide better stability, scalability, efficient spectrum management, and reduce communication overhead. Each node computes its weight and shares with its one hop neighbours, and a node with maximal weight becomes the cluster head. Subsequently, the neighbour nodes sharing the channel(s) with a cluster head join it to form a cluster. To provide fault tolerance, vice-cluster head is also selected along with cluster head. We compare the performance of our protocol with competing protocols in the CRN. Finally, we present analytic as well as simulation study of our protocol and provide a method to handle the cluster dynamics.

Index Terms— Cognitive radio networks, cognitive radio, clustering, distributed algorithm, localized algorithm

I. INTRODUCTION

A. Background

The rapid growth in mobile devices is leading towards the scarcity of bandwidth that requires the new generation of the network. A cognitive radio network (CRN) is such a network, where secondary users (SUs) opportunistically use the available spectrum not occupied by primary users (PUs) and vacate them on detection of PUs [1]. The concept of CRN was introduced by J. Mitola [2] in 1999 for utilization of radio spectrums in an opportunistic manner. It is an intelligent wireless ad hoc network, which automatically adjusts the various operating parameters like radio frequency, transmission power, modulation techniques, etc. Two architectures of CRN have been discussed in [1] as infrastructure-based CRN, and cognitive radio ad-hoc network (CRAHN). In infrastructure based CRN, a central entity, base station exists to manage the communication among the SUs, while in CRAHN, SUs itself manage the communication among each other. CRAHN further can be classified into two categories: 1) cognitive radio sensor network and 2) cognitive radio mobile ad-hoc network. Nowadays, both of these networks have received a profound interest from wireless communication researchers. Usually, SUs sense the idle channels and access them without interfering with PU transmission [3]. The availability of channels for SUs is highly dependent on PU activities [4]. If a pair of SUs wants to communicate then they need to rendezvous on a common channel. The common channel is determined by exchanging some control messages by SUs. Finding neighbours and corresponding common channels is itself a challenging task. However, a numerous of research articles [5-14] have been proposed for neighbor discovery in CRN, which can be used for clustering techniques.

B. Motivation

The motivation behind clustering in CRN is to reduce the network communication overhead, provide stability by managing the PU interference, and handle the dynamic changes in the network topology due to node mobility. The cluster formation in traditional wireless networks relies on a control channel to exchange control messages during the cluster formation. The dynamic nature of channel availability in CRNs makes it impractical to use static channels for exchange of control messages among nodes. The problem with existing techniques for clustering is that these techniques allocate single channel for intra-cluster or inter-cluster communication, which leads to the failure or trigger the re-cluster formation as soon as PU appears on that channel. In addition, few of the existing clustering techniques use the common control channel for control message exchange, which is not much reliable in the network scenarios where we