Construction of minimum connected dominating set in wireless sensor networks using pseudo dominating set

Jasaswi Prasad Mohanty [a],*, Chittaranjan Mandal [a], Chris Reade [b], Ariyam Das [c]

[a] Indian Institute of Technology Kharagpur, Department of Computer Science & Engineering, India
[b] Kingston University, London, UK
[c] Jadavpur University, Department of Computer Science & Engineering, Calcutta, India

ABSTRACT

In a wireless network, messages need to be sent on in an optimized way to preserve the energy of the network. A minimum connected dominating set (MCDS) offers an optimized way of sending messages. However, MCDS construction is a *NP-Hard* problem. In this paper, we propose a new degree-based greedy approximation algorithm named as Connected Pseudo Dominating Set Using 2 Hop Information (CPDS2HI), which reduces the CDS size as much as possible. Our method first constructs the CDS and then reduces its size further by excluding some of the CDS nodes cleverly without any loss in coverage or connectivity. The simulation results show that our method outperforms existing CDS construction algorithms in terms of both the CDS size and construction cost. CPDS2HI retains the current best performance ratio of $(4.8 + \ln 5)|opt| + 1.2$, $|opt|$ being the size of an optimal CDS of the network, and has the best time complexity of $O(D)$, where D is the network diameter. To the best of our knowledge this is the most time efficient and size-optimal CDS construction algorithm. It has a linear message complexity of $O(n\Delta)$, where n is the network size and Δ is the maximum degree of all the nodes.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Wireless ad hoc and sensor networks are popularly used in the health-care industry, food industry, agriculture and also in a wide range of military applications such as search and rescue, disaster control [1], etc. They form an important part of the next generation network in providing flexible deployment and mobile connectivity. Unlike wired networks or cellular networks, no physical backbone infrastructure is required in wireless ad hoc and sensor networks, thus offering new paradigms for routing. Wireless networks consist of either static nodes or mobile

nodes or a mixture of both. Each node, contains an omni-directional antenna, which broadcasts messages to all the nodes within its transmission range. Therefore, through broadcasting, a node can reach all of its nearby nodes with one emission. If communicating nodes are not within the single hop radio transmission range of each other, then a communicating session is established through multi-hop links by some intermediate nodes for relaying messages (multi-hop routing). One simple and intuitive method for multi-hop routing between non-adjacent nodes in wireless networks is flooding, in which each node retransmits a packet only once after receiving it. However, owing to the low available bandwidth of the wireless channels and the redundant retransmissions generated through pure flooding, the latter is not used as a communication mechanism in wireless networks. The most popular means of multi-hop routing in wireless networks is through the use of a

---

* Corresponding author. Tel.: +91 9437564198.
E-mail address: jasaswiprasad@gmail.com, jasaswiprasad@rediffmail.com (J.P. Mohanty).