Jammer Location-Oriented Noise Node Elimination Method for MHWN

Jianhua Fan, PLA University of Science and Technology, Nanjing, China

Qiping Wang, College of Communications Engineering, PLA University of Science and Technology, Nanjing, China

Xianglin Wei, PLA University of Science and Technology, Nanjing, China

Tongxiang Wang, College of Communications Engineering, PLA University of Science and Technology, Nanjing, China

ABSTRACT

It is crucial to find the location of the radio jammer for implementing anti-jamming methods and thus resuming the communication and management of MHWN. Nevertheless, due to the influence of environmental factors and the mutual interference of normal nodes, several unaffected nodes are unable to accurately identify whether they are affected by jammer and thus become noise nodes in the jammer location-oriented process, thereby influencing the precision of jamming localization algorithm and causing remarkable error. In this paper, an algorithm is put forward to eliminate noise nodes based on the Mean of Squared Distance among the nodes. Through calculating the Mean of Squared Distance of each node, the authors can find out the noise nodes and remove them. Simulation results in different jamming localization algorithms verify the correctness and effectiveness of the proposed algorithm. Analysis results reveal that the performance of the proposed algorithm is more prominent when the incidence of noise node is small.

Keywords: Jammer Location-oriented, Mean of Squared Distance, Multi-Hop Wireless Networks, Noise Node, Wireless Communication Technologies

INTRODUCTION

With the rapid development of wireless communication technologies, features such as convenient deployment, low cost and flexible structure have made wireless network get more attention, obtaining wide application in various fields. As the feasible framework to achieve the connection between universal networks in complex network environment, Multi-Hop Wireless Network (MHWN) has become a focus in academic and industry circles in recent years. However, the shared nature of wireless communication, the open access to wireless medium and the self-organized network composition make MHWN vulnerable to various network attacks, including

DOI: 10.4018/IJMCMC.2014100101
the mutual interference of normal nodes, malicious attacks from adversary, denial-of-service attacks and forge (Wood, Stankovic & Zhou, 2007). Especially, jamming attack and defense have been a big problem the researchers face in MHWN.

Jamming is defined as the act of intentionally directing electromagnetic energy towards a communication system to disrupt or prevent signal transmission (Adamy & Adamy, 2004). In the context of Wireless Sensor Network (WSN), i.e. a particular instance of MHWN, jamming is the type of attack which interferes with the radio frequencies used by network nodes (Shi & Perrig, 2004). Jamming attacks may be viewed as a special case of Denial of Service (DoS) attacks, which is defined as “any event that diminishes or eliminates a network’s capacity to perform its expected function” (Wood & Stankovic, 2002). All in all, Jamming attack prevents the transmitters from sending messages due to busy medium or dramatically decreases the signal-noise ratio at receivers to cause a large number of packet collisions (Xu, Trappe, Zhang & Wood, 2005). Attack initiator is called jammer and the area affected by jamming attack is called jammed area. The nodes located in the jammed area are called jammed nodes which can’t access to normal network services because of jammer’s effect on channel and network layer transmission (Pelechrinis, Iliofotou & Srikanth Krishnamurthy, 2011). So, how to detect and locate jammer effectively so as to eliminate jammer threat is an important premise to ensure the smooth and efficient operation of MHWN.

In MHWN, most of the existing jamming localization algorithms utilize the position and the state of nodes, especially those nodes located in the jammed area, to localize jammer through range-based or range-free schemes without depending on specialized devices, providing possibility for eliminating, avoiding and tolerating jammers. Nevertheless, due to the influence of environmental factors and the mutual interference of normal nodes, several nodes are unable to correctly identify whether they are affected by jammer and thus become noise nodes in the jammer location-oriented process, thereby influencing the precision of jamming localization algorithm and causing remarkable error. In order to bridge this gap, this paper focuses on how to identify and eliminate noise node, which is the premise to ensure the localization precision.

Firstly, the existing localization algorithms are briefly introduced and the problem of noise node elimination is formalized. Secondly, an algorithm is proposed to eliminate noise node based on the Mean of Squared Distance (MSD) among the nodes. According to MSD difference between nodes, the authors can identify and remove noise node. Finally, a series of simulation experiments are conducted to validate the effectiveness of the proposed algorithm.

The remainder of this paper is organized as follows: The authors review related work in Section II, and introduce the typical localization algorithms and the effects noise node made in localization in Section III. Then, the authors propose a noise node elimination method based on MSD in Section IV. The authors next conduct simulations to validate the proposed algorithm in Section V. Finally, the authors conclude this paper and talk about future work in Section VI.

RELATED WORK

To restore the service capability of MHWN, it is necessary to obtain the location of jammers which will be very helpful to apply further anti-jamming methods such as jamming tolerance, jamming avoidance and jamming elimination (Azim et al., 2014). Therefore, various jamming localization algorithms have been put forward in recent years.

Traditional jamming localization algorithms, which are based on the signal’s transmission characteristics in physical layer such as radio wave reflection, can be greatly affected by propagation environment, causing large localization error. Moreover, conventional localization
Recording and Reporting: Camera Phones, User-Generated Images and Surveillance
[www.igi-global.com/chapter/recording-reporting-camera-phones-user/48356?camid=4v1a](www.igi-global.com/chapter/recording-reporting-camera-phones-user/48356?camid=4v1a)

Imperceptible Simplification on Mobile Displays
[www.igi-global.com/article/imperceptible-simplification-mobile-displays/64364?camid=4v1a](www.igi-global.com/article/imperceptible-simplification-mobile-displays/64364?camid=4v1a)