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Performance Analysis of Wireless Sensor Network Using Cognitive Radio Concept

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Abstract— As the demand for wireless increases there is rapid development of various wireless technologies. The users want to use wireless communication services anytime and anywhere. Wireless Sensor Networks (WSNs) are expected to play an important role in future to provide reliable data transmission. But the traditional WSN works in unlicensed band and suffer from uncontrolled interferences from the networks sharing the same spectrum. As it resides in high Bit Error Rate there is increased delay in data transfer which results in less throughput. In this paper the WSN using cognitive concept is studied for reliable data transmission.

Index Term—Cognitive Radio Sensor Network; Delay Performance

I. INTRODUCTION

Wireless Sensor Network (WSN) is a network of wireless nodes that is used for the purpose of monitoring in various areas such as medical, environment etc. The nodes perform the required measurements, process the measured data and transmit the measured data to the base station over a wired or wireless channel. In applications such as health care it is required that immediate action is taken as soon as the data is received. Hence the data transmission should be reliable with minimum transmission delay. Also the current traditional WSN works in the license free spectrum which is crowded by the networks sharing the same license free spectrum and hence suffers from uncontrolled interference.

A WSN with cognitive radio technology is a promising solution for coexistence among multiple networks. It is capable of recognizing and utilizing the spectrum opportunities within the licensed bands, while avoiding interference with the primary networks [1]. As there is a great underutilization of a large portion of licensed bands, a significant amount of radio spectrum is available for cognitive based WSN. The idea of cognition for WSN will help to achieve a reliable and robust network. The term cognition can be defined as the ability to be aware of the environment, learning and reasoning from previous decisions and making decisions for the current situations [2]. Thus the network can adapt itself to different situations and achieve end to end goals. Cognition will help to design WSN that are more aware of the concurrent conditions of the network and make appropriate decisions and act accordingly.

In this paper we study a Cognitive Radio Sensor Network (CRSN) which opportunistically accesses the licensed spectrum by other networks. The paper is organized as follows. In section II overview of cognitive radio sensor network is given. Section III presents the related work. Results are given in section IV and section V concludes the paper.

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II. OVERVIEW OF CRSN

In traditional WSN the number of sensors in a cluster communicates directly with the cluster head (CH). Data transmissions are mainly from sensors to CH. The CH acts as a central station which is responsible for sending ACK frames and controlling signal messages to its member nodes. In real time applications the information collected by the CH is forwarded to next CH or to a sink. Fig 1 shows the traditional WSN.

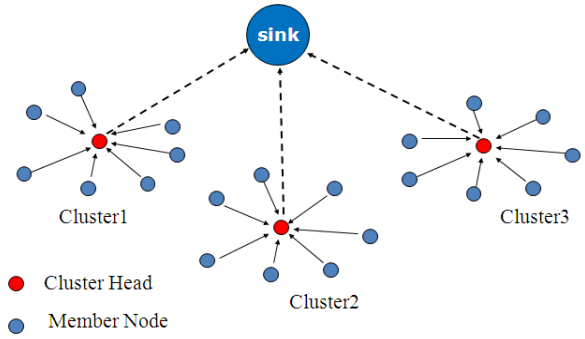

Fig 1: Traditional WSN

It is required the time line co-ordination between the CHs should be accurate so as to reduce the transmission delay. Hence the data collected by the CH is either processed locally or forwarded to a data sink through a high speed wired or wireless communication network. Thus the delay beyond the CH is much smaller compared to the transmission delay between the sensors and CH and hence it can be neglected. Therefore the work focuses on the performance analysis of transmission delay between the sensors and CH within a cluster.

In cognitive based WSN the network accesses the vacant channels in the spectrum when they are not used by its primary network. In the network each cluster uses a single frequency at any given time [3]. The sensor nodes in a cluster, changes to different frequencies as per the

availability of frequency channels. The sensing of available channel frequency is done by the CH. When the channel frequency becomes available all the data transmission between sensors and CH happens on that frequency and it is assume to be error free. Data transmissions are mainly from sensors to CH and transmissions from CHs are mainly of controlling signals along with ACK frames to the sensor nodes for reliable transmission. It is assumed that the channel loss can be realized immediately by the CH after which it starts sensing for new channels. If the channel becomes unavailable when the sensor is transmitting, the ongoing transmission may cause interference for the primary network before the device realizes the channel loss. To avoid this many approaches are adopted such as, if the sensor does not receive ACK in a predefined interval of time it assumes the channel is lost or the sensor can send a short RTS frame to the CH before data transmission and the CH replies with CTS immediately [4].

III. RELATED WORK

The work focuses on evaluating the performance of the cognitive based WSN through simulation using ns-2 simulator [5]-[6]. The performance is analyzed in terms of transmission delay, required by the packet to reach from source to destination. In a WSN, the data transmission is between cluster head and its member nodes which consist of information signal from member nodes to cluster head and control signals from cluster head to member nodes. It is required that the transmission delay between the cluster head and member nodes be reduced. This transmission delay can be due to link failure, interference etc. To avoid this transmission delay we have changed the frequency used by the network for its data transmission. For simulation purpose we have assumed a set of frequencies. The network shifts to different frequency after a predefined interval of time and transmits its data. The results are then compared with the results obtained from the network which does not use frequency switching for it data transmission.

Table1. Simulation Parameters

Sr.No	Parameters	Value
1.	Number of nodes	Variable
2.	Number of channels	10
3.	Routing protocol	AODV
4.	Traffic type	Constant Bit Rate
5.	Packet size	512 bytes
6.	Queue length	50
7.	Simulation run time	500ms

IV. RESULTS

Simulations have been established for different number of nodes in the cluster, in cognitive based WSN. The network switches to different frequency for its data transmission in the cluster. The simulation results are also obtained for the network where there is no frequency switching for data transmission in cluster. Fig 2 plots and compares the transmission delay performance of cognitive based WSN and traditional WSN.

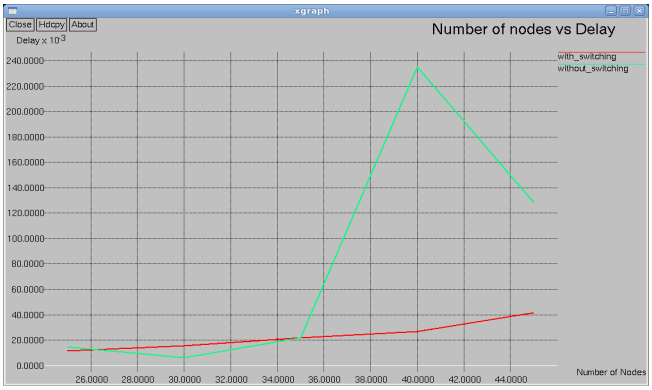

Fig 2. Comparison of transmission delay for two different networks

V. CONCLUSION

We have studied the transmission delay performance of cluster based WSN using cognitive concept. Results show that as the number of nodes in the cluster of cognitive based WSN is reduced the transmission delay required by the packet to reach from source to destination also reduces which is not the case in traditional WSN. This reduction in transmission delay makes the network reliable.

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REFERENCES

[1] O. Akan, O. Karli, and O. Ergul, "Cognitive radio sensor networks," IEEE Network, vol. 23, no. 4, pp. 34-40, July 2009

[2] Simon Haykin, "Cognitive Radio: Brain-Empowered Wireless Communications," IEEE Journal On Selected Areas In Communications, Vol. 23, No. 2, February 2005

[3] Zhongliang Liang, Shan Feng, Dongmei Zhao, and Xuemin (Sherman) Shen, "Delay Performance Analysis for Supporting Real-Time Traffic in a Cognitive Radio Sensor Network" in IEEE Transactions On Wireless Communications, Vol. 10, No. 1, January 2011

[4] S. Feng and D.Zhao, "Supporting Real-Time CBR Traffic in a Cognitive Radio Sensor Network," in IEEE Communications Society subject matter experts for publication in the WCNC 2010 proceedings.

[5] R.Nathiya and S.G.Santhi, "Energy Efficient Routing with Mobile Collector in Wireless Sensor Networks (WSNs)", International Journal of Computer Sciences and Engineering, Volume-02, Issue-02, Page No (36-43), Feb -2014

[6] www-sop.inria.fr/members/Eitan.Altman/COURS-NS/n3.pdfs