

# "ZIA" Zero-Interference Algorithm for Hybrid Wireless Sensor Networks

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## Abstract

Wireless sensor networks catch the attention of researcher's because of its high potential application areas and low implementation cost. WSN consist of sensor devices deployed across a geographic area to sense the environment by measuring physical parameters such as temperature, motion, etc. The most important issue regarding the design of WSNs is the energy consumption since these networks are usually deployed in remote areas where the replacement of batteries is impossible. A WSN may deploy more than one wireless technology and form a hybrid sensor network. This paper presents a new algorithm to avoid interference while using multiple wireless technologies in a hybrid wireless sensor network.

## Keywords

Hybrid sensor networks, WSN, sensor nodes, Interference.

## I. Introduction

Wireless sensor network comprises with co-operative, low power, distributed wireless nodes, which collect the information from geographical environment. Small size, low cost nodes are generally deployed to get the data by means of its sensors, which equipped with sufficient processing power and memory unit. WSN get huge popularity because of its wide range of application areas like in Military application for battlefield surveillance, targeting, battle damage assessment, biological and chemical attack detection etc. in Environmental application tracking of birds, small insects and animals, environmental condition monitoring, forest fire detection, biocomplexity mapping of the environment, flood detection and disaster management etc. in Health care application diagnosing the diseases, monitoring and tracking the patients telemonitoring the human physiological data, in Home applications as home automation appliances, person locator, and location awareness. Some other commercial applications includes environmental control in office building, interactive museums, detecting and monitoring the care thefts, robotics control, virtual keyboard and in traffic monitoring. [4, 7, 8]

With all these applications WSN also experience with many security challenges, threats and attacks. Here the security associates with Data confidentiality, authentication, integrity, availability, freshness, Time synchronization and secure localization. A good network design not only take care of these objectives, it suppose to handle with active attacks (monitor or modify the data stream in the communication channel) and passive attacks (an unauthorized user or adversary monitor). Many researchers' works in efficient sensor networks designing for low power requirement, secure, good quality, low cost high performance and hybrid network. A design of robust hybrid WSN proposed in [8]. This design was based deploying two wireless technologies (i.e. Wi-Fi and Bluetooth) for 2.4GHz ISM band with in a single network. The chances of interferences increase when different nodes work simultaneously in same frequency bands. This paper proposed a Zero Interference Algorithm (ZIA) for hybrid wireless sensor network working with dual technology mode. The proposed algorithm may also works

## II. Previous work

1. Standards for wireless Wi- Fi, Bluetooth, Wi-Max, Zigbee (wireless personal area network) are describe in this paper. It also presents the architectural detail of sensor node (consists with sensors, transducers, memory and power supply).
2. An encrypt messages sent among sensor nodes and the keys used for encryption purposes must be agreed by communicating nodes. Due to resource constraints, achieving such key agreement in wireless sensor networks is non-trivial.
3. This paper presents the secure sink node architecture as 2 tier scheme for sensor network security.
4. In this survey paper analyze the security aspects of the sensor networks like requirements of WSN, type of attacks and security mechanism etc.
5. This paper presents the secure routing in sensor networks as routing protocols are susceptible to a number of attacks depending upon the environment in which protocol is used and its application domain.
6. This paper gives a new kind of security scheme known as Trust System where each node maintains the repudiation for other nodes of several tasks and uses its performance and reputation to evaluate their trustworthiness. This Scheme reduce the Effect of malicious node attack and dynamically adopt the behavior of nodes by using other factors however it is a very difficult problem to select the factors.
7. This paper presents a security framework known as "Wireless Sensor Networks Security framework (WSNSF)" to provide a security solution against the known attacks in sensor networks.
8. It provides a hybrid design of wireless sensor network in which two wireless technologies (Wi-Fi and Bluetooth) are used for 2.4GHz ISM band. This design deploys the best features of both technologies according to application scenario.

## III. ZIA (Zero Interference Algorithms): The proposed algorithm

As in [8] the co-existence of Wi-Fi and bluetooth technologies for same 2.4GHz ISM band may invite interference between Bluetooth and Wi-Fi will occur any time there is an overlap of both time and frequency between transmissions associated with each technology. Interference occur when a Wi-Fi receiver senses a Bluetooth signal at the same time when a Wi-Fi signal is being sent to it and secondly when a Bluetooth receiver senses a Wi-Fi signal at the same time when a Bluetooth signal is being sent to it. Wi-Fi considered more susceptible to interference because bluetooth nodes have ability to "hop away" from interfering signals and Wi-Fi inhabits a specific 22 MHz pass band, so it cannot "hop away" from interference

While using multiple wireless technologies in a single network area an issue of co-existence and interference arise. There is need to develop an interference free communication among the

participating nodes in a sensor network. This paper proposed a zero interference algorithm (ZIA) to improve the performance of network and reduce the overall communication head. Before discussing the proposed algorithm first look-out the requirements and arrangements.

**Data Packet format**

<b>Port no.</b>	<b>Time stamp</b>	<b>Data</b>
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Fig. 1: Data Packet Format

Data packet format contains the port no. of the node data and relative time stamps. Time stamp refers the time of data generation (sensing) different data packet may contain same data but they should have different time stamp value.

**Node information table (Nod\_tab)**

Node No.	Sub Nodes	Type
		Homogenous / Heterogenous
W <sub>M</sub> ( i=1 to n )	BT <sub>M</sub>	attributes
	( i=1 to n )	“
BT <sub>M</sub> (1-m) ( i=1-<8 ) ( m=1-<8 )	BT <sub>M</sub>	“
	( i=1-<8 )	“
	( i=1-<8 )	“
	( i=1-<8 )	attributes

Fig. 2: Node Information Table

Node information table listing both Wi-Fi and Bluetooth nodes separately. Sink node for the network is a Wi-Fi node, which collects the information from other distributed nodes. BT nodes may form a scatternet to cover large geographical area and sensing great amount of good information. Nodes may be homogenous or heterogenous depending up on the application and network design. Usually nodes are deployed at the time of sensor network establishment.

Sink node collects the data from its sub nodes (Wi-Fi or bluetooth). Each Wi-Fi node deploy many BT nodes in its range area, which collects the information (homogenous / heterogenous) at large scale with great accuracy. BT nodes form a piconet for communication and for covering large area they may form scatternet. There is one master node in a piconet and max. seven slave nodes, a slave node may work as master node for any other piconet. Data collection pattern from associated nodes are shown in above figure.

**Data Management**

**Wi\_Super node**

W <sub>M</sub> (i=1 to n), i=j						
BT <sub>M</sub>	BT <sub>M</sub>	--	BT <sub>M</sub> (1-j>n)	BT <sub>M</sub>	--	BT <sub>M</sub>

**BT\_Scatternet**

BT <sub>M</sub> (if master)						
BT <sub>M</sub>	BT <sub>M</sub>	BT <sub>M</sub>	BT <sub>M</sub>	BT <sub>M</sub>	BT <sub>M</sub>	BT <sub>M</sub>
1	2	3	4	5	6	7

Fig. 3 : Data Management Table for wi\_super node and BT\_scatternet

**IV. Zero Interference Algorithm**

Zero Interference Algorithm (ZIA) for hybrid wireless sensor network is classified into two sections. First section deals with the zero interference in super nodes (Wi-Fi nodes) and second section is for sub nodes (Bluetooth nodes).

**Wi\_Super node comm. Algorithm**

```

// Data Packet ready to forwarding from WNsender to WNreceiver //
1. Put Data Packet in sending buffer and check the communication in local region
2. If
   Any communication occurring // in both WNsender to WNreceiver region //
3. Then
   Hold the data Packet and go to 1
4. Else
   Send Data Packet from WNsender to WNreceiver // no interference occurred //
    
```

For same band (ISM) super nodes communicate only when, if there is zero communication occurs in the region of both transmitter side as well as receiver side by any of super/sub node.

**BT\_Scatternet maintenance Algorithm**

```

1. Node select //select have the address of the selected node//
2. String name //having name of the selected node//
3. If(Event==Add node)
{
   Int n //input the no of new node//
   Int number //number of child node having selected node//
   While (number+n>8)
   Re-enter the value of n
   For (i=number+1; i<number+n; i++)
   {
      New node (name+i)
      //add to the tree
   }
}
4. If(event==Delete)
Delete the selected node and all child node associated with it
5. If(Event==search)
String srch //enter the name of the node//
6. If(Event==search and delete)
String srch //enter the name of the node//
Search and delete
    
```

Sub nodes form a piconet with one master and seven slaves (maximum) nodes and Scatter net is formed to deal with more numbers of node. All sub nodes forward the data in a serial fashion.

## V. Conclusion

Many parameters such as battery energy, memory, computation, and communication capacities make WSN very difficult to achieve quality and performance. The process of data collection and forwarding may be interfered by other signals. The proposed ZIA- Zero Interference Algorithm for hybrid wireless sensor network identify and remove all possible cases of occurrence of interference successfully.

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