Application of Multi-Channel Communication Technology in Wireless Sensor Networks

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Abstract. This paper mainly introduces the application of multichannel communication technology in wireless sensor network. The corresponding solutions are proposed based on the analysis of the structure and characteristics of wireless sensor, and the multi-channel MAC protocol in wireless sensor network. In this paper, multi-channel communication technology in wireless sensor network (WSN) is studied, the existing problems and reasons are analysed, and some solutions to further promote the further development of the technology are put forward. With the wide application of WSN, the security of WSN has been paid more and more attention. In this paper, the existing time synchronization protocol, from the security point of view, and the fault tolerance design of the fits protocol. The protocol has an intrusion detection mechanism, which can detect the attack of malicious nodes in time synchronization. Aiming at the small deviation of slow attack and the problem of time synchronization error, information fusion is based on the quality principle, and according to the time synchronization information of different nodes, we make random weighted average correction for local time nodes. The simulation results show that the fits time synchronization protocol has good intrusion detection and fault tolerance capability.

1. Introduction
Traditional wireless sensor network used single channel to communicate, and the nodes in the network use a unified frequency for wireless signal transmission. Single channel communication has the advantages of simple implementation, easy network node discovery and convenient networking. But the number of nodes within the network gathered in a communication channel, resulting in increased competition, mutual interference and other serious shortcomings, especially when using the wireless channel network is disturbed, the whole network communication will not face the risk, network paralysis, so the single channel cannot provide reliable and efficient communication network which is contradictible with the rapid development of the wireless sensor network [1]. Multi-channel communication can make the multi hop data transmission to the monitoring centre or the Internet, users can manage the wireless sensor through the Internet or network monitoring centre. Due to the communication ability of common sensor nodes is weak, wireless sensor network is often based on geographical division of many groups of each cluster to set up a communication ability of the node as cluster head, cluster head is used for collecting the cluster nodes information, and then through the multi hop mode information is transmitted to the sink node, the sink node is responsible for the exchange the information from the outside world. [2] Of course, sometimes in order to balance the...
energy of the whole network and easy to manage, the sink node can also be served by the common sensor nodes through the optimization strategy [3].

![Figure 1 Schematic diagram of Wireless Sensor Networks](image)

**2. Key technologies involved in the system**

**2.1 Technology of multi-channel communication for WSN**

The traditional wireless sensor network, the node uses a single channel of communication; effective transmission in the range of radio waves between nodes prone to interference, at the same time, the node will be disturbed by ambient noise. [4] Multi-channel environment, in a hop range of nodes, can be used for communism of these belong to the middle of the communication protocol. Therefore, multi-channel communication requires high performance layer protocol to solve the problem of allocation and negotiation of multi-channel communication needs to solve [5]. Safety problems with single channel synchronous communication, multi-channel communication also needs to solve the problem of time synchronization which is an important part of WSN, nowadays it is more mature, can provide accurate time for communication and the application of WSN [6]. But the traditional time synchronization technology for security issues to consider less, wireless sensor network time synchronization protocol there are many security vulnerabilities. Multi-channel communication model is shown in Figure 2.

![Figure 2 Sketch map of multi-channel communication model](image)
2.2 Multi channel MAC protocol
Multi-channel MAC protocol is a key part of the wireless sensor network communication channel. Need to solve the rational allocation of channel resources among nodes in the network, and is found between nodes, making node communication strategy, realize the communication between nodes of low power consumption, control channel restrictions, nodes scattered in multiple channels at the same time to negotiate, reduce communication competition, and a channel is disturbed, it will not affect the operation of the whole network. [7] However, due to the lack of control channel, the exchange of control information between nodes becomes difficult, which makes the implementation of the protocol become more complex. [8] The schematic diagram of multi-channel MAC protocol is shown in Figure 3.

![Figure 3 Schematic diagram of multi-channel MAC protocol](image)

2.3 Research model of spectrum sensing technology
Unlike the non-authorized band congestion is assigned too many existing special kinds of wireless spectrum resource system, but there are different degrees of idle in time and space, and even the formation of the so-called “spectrum hole” phenomenon. [8] If the effective use of these idle resources will undoubtedly of wireless sensor network nodes are very limited, it cannot directly apply mature spectrum sensing technology in cognitive radio. Therefore, it is needed to study the new spectrum sensing technology for WSN to detect the status of wireless channel. [9] Cognitive radio model schematic diagram shown in Figure 4.

![Figure 4 Schematic diagram of cognitive radio model](image)
3. Multi channel broadcast problem in Wireless Sensor Networks

3.1 Research status and key problems of multi-channel broadcast problem
In wireless sensor networks, because of its good anti-interference and high throughput, multi-channel MAC protocol get people's attention, especially the multi-channel MAC protocol, nodes are randomly selected channel, better to avoid the interference and collision of communication between nodes, and achieves good performance. Multi-channel MAC protocol design issues of how to improve Mbps, nodes in the network are in the same channel, using the broadcast nature of radio waves, radio information transmission of a node, the node in the radio communication range can receive [10]. Thank broadcast, and reduce the broadcast delay, is also the key problem to be solved. In short, an efficient multi-channel broadcast mechanism, the need to achieve low power consumption, low latency, high coverage and low redundancy requirements, in order to meet the application needs of wireless sensor networks. The schematic diagram of multi-channel broadcast model is shown in Figure 5.

![Figure 5 Sketch map of multi-channel broadcast model](image)

3.2 Index based broadcast tree introduction
How to form a minimum spanning tree cannot be strictly reached the ideal state, may require more forwarding times to complete the full coverage of the node. The ideal exponential broadcast tree is shown in Figure 6.

![Figure 6 Schematic diagram of an ideal exponential broadcasting tree](image)

3.3 Architecture of distributed tree type broadcast protocol
The DTB protocol based on distributed mode, the sending node before sending broadcast packets, first broadcast a series of training package, network node according to the transmission path of training
package, to determine the relationship between father and son nodes themselves, forming a sending node broadcast tree, after repeating the received confirmation packet information in deciding whether to add it to their sequence, namely, new nodes are added to the first to send him the sequence node sends broadcast packets. The structure of the distributed tree broadcast protocol is illustrated in Figure 7.

Figure 7 Schematic diagram of distributed tree based broadcast protocol

4. Fault tolerant time synchronization protocol for Wireless Sensor Networks

4.1 Security analysis of Wireless Sensor Networks
Time synchronization protocol is an important part of wireless sensor networks. [13]Many applications of wireless sensor networks and communication protocols are based on the accurate time synchronization. A number of applications exist in wireless sensor networks with the classical time synchronization protocol focusing on how to improve time synchronization accuracy and reduce the energy consumption.

4.2 Attack type of time synchronization protocol
Due to the extensive nature of the node distribution and the limited resources of the nodes, the wireless sensor networks are vulnerable to external attacks, and even the nodes are captured. Wireless sensor networks may be affected by the attacks can be divided into physical attacks, data attacks and resource attacks, and other types of. These attacks will affect the WSN, and then interfere with the operation of the time.

4.3 Least mean square error method
In the wireless sensor network time synchronization protocol, node according to the received time synchronization in packet transmission time, and receives the synchronization packet time to adjust its own local time, achieve the purpose of time synchronization and transmission node. But in the practical application, the accuracy will be affected by the transmission time of data packet processing speed, and accuracy of the When disturbed, the calibration time of the local node is small, and it is slow. Therefore, in an environment that cannot determine the security of the neighbour nodes, we can use the local node calibration time as a reliable time source. Using local time stability, to estimate the variance of the transmission time of different nodes [15].
5. Summarize and Expectation
Based on the wireless sensor network as the research background, multi-channel communication protocol involved, multi-channel spectrum sensing, the key issues of multi-channel radio and wireless sensor network time synchronization protocol security and so on. For multi-channel communication and pin, also avoids the bottleneck effect because the control channel congestion or interference caused by the. In the wake of the pseudo random sequence, the node wakes up to solve the problem of the lost node caused by the overlapping of the sending node and the receiving node.

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