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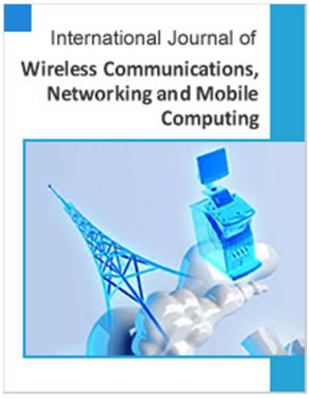

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Further Discussing About the Conflict Problem of RFID Tag

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Abstract

RFID systems are generally composed of two parts label (Tag) and reader (Reader) components. When the system is at work, if there are multiple tags send data at the same time, there will be mutual interference, that is, collision, and the results will lead to transmission failure. Hence the need to develop appropriate anti-collision algorithm, in order to avoid or reduce collisions, thus effectively improving system performance. The paper describes that when two or more tags in a wireless channel, and transmitting an identification signal to the reader, the signal will overlap, causing the reader can not normally be resolved. By comparing of the advantages and disadvantages of several anti-collision algorithm, clarify the need for anti-collision algorithm improvements.

1. Introduction of Radio Frequency Identification Technology

Radio Frequency Identification RFID is the acronym for radio frequency identification, commonly known as RFID. RFID is a radio frequency identification technology to read and write data using radio, in order to identify the technical article, which is a wireless communication technology and semiconductor technology combined with the product, it is one of the most widely used non-contact automatic target recognition technology. Identification system consists of an electronic tag reader and composition, automatic target recognition and access to relevant data RF signal, to identify work without human intervention. RFID technology has a strong environmental adaptability, anti-interference ability, all-weather use, almost free from pollution and the effects of moisture, but also to avoid mechanical wear. RFID tag data storage capacity, information processing speed, storage information can freely change the stored data can be encrypted, the label has no direct end-user open the physical interface, to better ensure the safety of equipment. Also, you can use some encryption algorithm for secure management of information between the reader and the tag can also be mutual authentication, secure communication and storage. RFID technology involved in many high-tech fields of information, manufacturing, materials, covering integrated chip design and manufacturing, antenna design and manufacturing, packaging labels, systems, information security technology. With the continuous development of chip technology, antenna technology and computer technology, RFID system size, power smaller, more low cost, functions are becoming more flexible, fast and convenient operation, coupled with its good multi-target recognition, moving target identification, tracking and management of convenience goods prominent characteristics, widely used in various fields of production life. In many areas of the logistics system, retail industry, identification, transportation management

and other farming industry and the pharmaceutical industry, RFID recognition technology has become the 21st century, one of the hottest technologies. According to the application purpose and different application environment, the components of the RFID system will be different, But basically consists of three parts: the electronic tag, reader, antenna [1, 3].

Electronic tag (or tag, transponder) is composed of a coupling element and a chip, the built-in antenna chip storage of electronic data of a certain format, as identification information for identifying items, is the real data carrier frequency identification system. The built-in antenna for communication and RF antenna.

The antenna is a device for transmitting, receiving data transmission between tag and reader.

The reader is an equipment which to read or read / write electronic tag information , the main task is to control the RF module to transmit and receive signals read tags, tag response, object identification information on the tag is decoded, the object identity information and other relevant information transmission on the tag to the host for processing.

2. Description and Solution of RFID Tag Conflict Problem

2.1. The Conflict Problem Description

RFID technology application system is mainly composed of RFID tags, tag readers and corresponding computer system components, and when the scene you want to read an RFID tag affixed to the object, the tag reader sends electromagnetic waves of a specific frequency RFID tag, RFID tag is an electromagnetic wave trigger, identification code information stored inside will send. The system will be through the tag reader identification of the goods and the corresponding information processing. However, if there are multiple RFID tag receives the electromagnetic waves and at the same time send a message, the tag reader receives signals will interfere with each other, inevitably label reading conflict.

Currently, the way to solve conflict RFID tag reader is mainly based on two anti-collision algorithm namely: anti-collision algorithm based on slot and ALOHA anti-collision algorithm based on tree structure. The former is the use of a randomly selected transmission time mode, system identification relatively poor reliability, but the ease of design honor; the latter is used binary search algorithm, high reliability, system identification, but the system needs to be honored and RFID tag identification code information linked to the hardware design is more complex.

Therefore, low-cost RFID tags are generally based on the time slot ALOHA anti-collision algorithm to design, how to improve the reliability of the system identification algorithm is a low-cost RFID tag application system research priorities The existing time division multiple access collision algorithm is divided into two kinds: one kind is the Anti collision algorithm based on binary tree, an other is a algorithm which based on ALOHA mechanism.

2.2 Anti Collision Algorithm Based on Binary Tree

Binary tree search algorithm is an algorithm without memory, which is the label does not have to store the previous query conditions, which can reduce costs. In this algorithm, the reader is not a query of data bits, but a bit prefix, only the serial number with prefix matching the query tag transmits its serial number reader only in response to the command. When only one tag reader response can succeed identification tags, when there are multiple labels response when the next cycle, the reader put the query prefix adds a bit 0. By increasing the prefix, the reader will be able to identify all of the tags. Binary tree search of the premise is to identify the exact location of reader data collisions, the choice of Manchester coding can detect collision bit.

Features binary tree search algorithm is: a high stability, easy to use software, throughput of up to 36.4%. But the ID can not be too long, the longer ID longer needed, when the time exceeds a certain limit, this algorithm will no longer apply. Backward binary tree search algorithm is similar to the binary tree search algorithm, the first to identify an individual label, the next query command takes back the policy, obtained from the parent node until after the end of the binary root node without conflict. RFID System Features retreat binary tree search algorithm is: identifying a single tag on average only twice, identification tags totaling N 2N + 1 times, channel utilization stable at 50%, but there are not applicable ID is too long shortcomings. Binary tree search algorithm and Backward binary tree search algorithm increases the length of the label ID, you can not correctly identify the tag, but will increase the burden on the system.

2.3. Anti Collision Algorithm Based On ALOHA

2.3.1. The Pure ALOHA Algorithm

Multiple access mode of pure ALOHA algorithm used is a kind of random time division multiple access, or random multiple access. When any one of radio identification tag received the command from reader, immediately sends its symbol to the reader with a fixed length packets, in the process of sending data, if there are other tags also sending identifier, the signal they occur between the superposition leads to conflict or Part of the conflict. When receiving signal, the reader will check whether there is a conflict. If there is no conflict, reader correct identification tag identifier and send a confirmation message; if there is a conflict, the reader sends confirmation after the conflict, the tag will independent to wait a long time to send a signal at random, and until success.

Pure ALOHA method only for read-only reader, as long as there is a packet, the packetimmediately from the tag to the reader. This type of tag is usually only a few data (serial number) is transmitted to the reader, and in the cycle, a cycle

of these datacontinuously sent to the reader, data transmission time is only a small part of the repetition time, resulting in a long intermittent in transmission between.

Between the repetition time each tag the difference is very small, so there is a certainprobability, two tabs can their data set in different time periods, so that the packettransmission will not conflict with each other. This method is simple, easy to implement, but the channel utilization rate is only 18.4%.

To solve these problems, we propose a slot ALOHA algorithm and frame slotted ALOHA algorithm to improve ALOHA algorithm. Slotted ALOHA algorithm using an RFID reader control system because there are slots in the synchronous data transfer, the time zone may collide shortened by half, throughput up to 36.8%, relative to pure ALOHA algorithm doubled, but still limited to read-only tag. Frame slotted ALOHA algorithm using an RFID system is suitable for transmitting large amount of information occasions, but the label is much greater than the number of the number of time slots, the time to read the label will greatly increase in the number of tags is less than the number of slots when the number of slots can be wasted.

2.3.2. Slotted ALOHA Algorithm Based On Frame (FFSA)

To this problem, some people put forward a improved scheme, namely slotted ALOHA algorithm (S-ALOHA).The pure ALOHA algorithm's time is divided into several time slots, each slot is equal to or greater than the tag identifier of the time, and each tag can only be in the beginning of the time slot time sending identifier. The S-ALOHA protocol to send time synchronization by RFID system, the reader through beginning of the time slot synchronous control command to realize time slot. Because the system time synchronization, utilization rate of channel is 36.8% [5], it is two times as pure ALOHA.as shown in Equation, showing that the figure indicated by solid lines.

Basis on S-ALOHA, a plurality of slots organized as a frame, reader according to the frame as a unit for identification, which is based on frame slotted ALOHA (FSA). It is a time division multiple access mode, which can improve the throughput rate of the ALOHA method. The slot length determined by the system clock, the control unit must be with the clock synchronization. For RFID system, the transmission of data packets in the tag canonly synchronization slots within the set, must be on all the tags simultaneously by areader control. Using a slotted ALOHA, to transmit data packets begin alwayssynchronous time slot, so compared with the ALOHA method simply, conflict may arisetime only half as much, so that when the ALOHA method of S throughput rate:

$$S=G*e(-G) \quad (1)$$

By the equation above, exchange data packets in G=1 throughput rate of S was 36.8%.Therefore, because of this simple improvement, the channel utilization rate has doubled. As with pure ALOHA, after the conflict, the tag is still a random time delaydispersion retransmission. Slotted ALHOA system throughput rate of S in the exchange of data packet G approximately reaches the maximum value 1. If there are many tags in the range of reader, as existing slot, with the addition to tag, so throughput quicklyclose to 0. In the worst case, after several search may also sequence number has not been found, because not only tags can be alone in a time slot and successfully sent.Therefore, to get enough number of time slots, this approach can reduce the performance of the anti-collision algorithm.

2.3.3. Dynamic Frame Slotted ALOHA Algorithm (DFSA)

Dynamic frame slot slot ALOHA (Dynamic Framed Slotted ALOHA) referred to as the DFSA algorithm, the algorithm to improve the recognition rate by changing the tag ofthe time slots of a frame size. In order to determine the frame size, number of time slots are used to tag and conflicting slot number information. This algorithm is the use of the number of empty slots, slot number only one tag transmission conflict slot and slot to adjust the frame size, the conflict of the slot size specific limit, readerincrease the frame size. If the conflict probability is less than a certain limit, the readercan reduce the frame size. Because the reader to read cycle, the frame size is set to a minimum, so when the tag number not much, read and write without the frame sizeincrease a lot can effectively identify tag. When the tag number, the reader todecrease conflict must adjust the frame size. The DFSA algorithm can solve BFSA algorithm has the problem of low efficiency of recognition. In the DFSA algorithm, the time slot number N of each frame are dynamically generated. Thus it can be seen thatthis algorithm is simple, easy to realize, and can fully adapt to the dynamic changes inthe number of tags, very suitable for use in RFID technology.

In order to obtain the maximum system throughput, the number of time slots in a frameof a DFSA algorithm need statistics at the end this intra tag reading success, idle and collision, and then according to the various estimation algorithm to estimate the number of tags, to determine the number of slots matching, even if the frame slot to send the next length is equal to the estimated tags the number of. There are many ways to tagestimation, for example:

Minimum prediction [5] (LOWBOUND): the conflict happens in a time slot, at least 2 more tags at the same time, can predict the number of tags collision of at least 2*ak.

Schout [2] assumes that the tag selection slot with Poisson distribution prediction of 1Schout, when the system reaches the maximum throughput, the collision of a time slotrate of Ctags=0.4180, so the number of tags in a time slot collision is 2.39, which canpredict the number of tags are not identified 2.39*ak.

Vogt [5]: it is by comparing the actual success, idle, the number of slots and the theory of conflict Power, conflict free, slot number results for minimum error to predict unknown tagnumber, i.e.:

$$\varepsilon = \min \left\| \begin{pmatrix} c0 \\ c1 \\ ck \end{pmatrix} - \begin{pmatrix} a0 \\ a1 \\ ak \end{pmatrix} \right\| \quad (2)$$

Among them, C1, CK, C0 value of actual measured success, idle time slot, conflict. 2*[C1+2*CK...], In the tag number N (C1+2*CK)] to find the minimum e values, the corresponding N value is the prediction of the number of tags.As shown in figure 1.

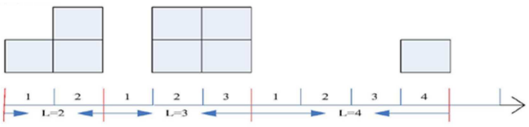

Fig. 1. *Schematic diagram of dynamic frame slotted ALOHA algorithm.*

2.3.4. Packet Frame Slotted ALOHA Algorithm (GFSA)

Frame slotted ALOHA algorithm is limited to the maximum number of slots per frame is 256. When the tag is far greater than the number 256, the system is unable to improve throughput by increasing the number of slots. To solve this problem, based on the proposed DFSA algorithm grouping frame slotted ALOHA algorithm (GFSA). Reference [3] shows that when the tag number is more than 354 all divided into two or more sets of tags, reader identification tag for each group separately, which can well improve system throughput. Figure 3 is a general DFSA algorithm and packet GFSA algorithms compare more than 400 the number of tags used to identify the total number of slots, the initial slot is set to 256. The results in Figure 3 show that the number of labels more superiority grouping algorithm GFSA more obvious. However, this algorithm is to be done in the original DFSA algorithm, many modifications, such as read and write commands need to add packet parameters, labels need to identify and save your own packet sequence number, which makes the implementation has become somewhat difficult.

2.3.5. Slotted Random Algorithm (SR)

Slotted random algorithm, there is no concept of frames, replaced by a recognition cycle. Identification cycle refers the reader to identify the two transmission start command (Query) intervals. SR algorithm is also to make the tag selector slot answer, but the difference is that, in the frame slotted ALOHA algorithm, a frame can be changed only when all slots are completed after the number of slots, so unrecognized tag reselection; and SR algorithm In a recognition cycle can be changed at any time the number of slots, so that does not recognize the label re-select, implement adaptive process the number of slots.

Such as ISO / IEC 18000 - 6 Type C [5], Query identification process is transmitted by the read command to start. Q. parameters command includes slots Choose a random number as their slot counter value in the label range 0 ~ 2Q- 1. When the slot counter value is equal to 0, the tag response. If the tag is successful identification reader, exit identification system. The reader by transmitting a command to start the next time slot (QueryRep), so that the label of the slot counter value by 1, if the slot counter value is 0 (the previous time slot collision label), it is referred to as the maximum value (7FFFh).

When the reader need to change the number of slots, it will send a command to change the time slot parameters (QueryAdjust), so that the original Q value plus 1 or minus 1, then the label will re-generate the slot counter value. The number of slots is an adaptive process by sending a QueryAdjust to achieve.

According to the reader to identify cases several time slots (instead of a period), to increase or decrease the time slot parameters Q, enable timely and effective manner to reflect the dynamic changes tag number. A simple algorithm is to design a Q value parameter as a reader in Qfp Q float. Every reader will change Qfp value based on responsiveness to the label, and then Qfp rounded to an integer value. Q If the integer value is different from before, the reader sends a QueryAdjust, so Q is equal to the integer; otherwise, the reader does not change the Q value, send QueryRep command[6].DFSA initial slot number and the same algorithm, take 16, namely Q = 4.

3. Conclusion

Figure 2, Figure 3 describe the identification of a certain number of labels required total number of slots and the system throughput. Another figure, FFSA 128 and FFSA 256 with 128 and 256 respectively represent the number of slots fixed frame slotted ALOHA algorithm; DFSA I and DFSA II represent estimation algorithm uses the first tag and the second tag estimation algorithm for dynamic frame slot ALOHA algorithm; SR algorithm Representative slotted random algorithm, and the Q value algorithm using the method described in Section 2. [1]

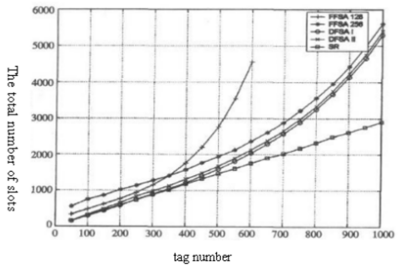

Fig. 2. *Tag numbe VS Total slots.*

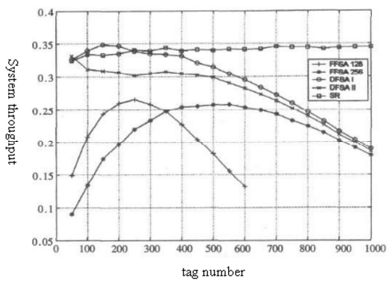

Fig. 3. *Tag numbe VS Total slots.*

From FIGS. 2 and 3 can be seen, the use of a number of slots for the FFSA algorithm 128, when the label number more than 300, the total number of slots required for the rapid growth of the identification tag. Uses the same number of slots as the FFSA algorithm 256, the total number of slots is also showing rapid growth trend. FFSA algorithm system throughput and low throughput performance unstable.

If using DFSA algorithm, the total number of slots needed for identification tag slightly. When the tag number less than 600, higher system throughput and relatively stable; when the label number is greater than 600, as limited by the maximum number of time slots 256, the system throughput rate began to decline. At this point can increase system throughput by GFSA algorithm. Simulations using two different algorithms to estimate tag DFSA algorithm, its performance almost. But to achieve perspective, DFSA II algorithm is better, because it is easy to implement.

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References

[1] Liu Jia, Zhang Youguang. based RFID anti-collision algorithm analysis slot communication with the network. Electronic technology. (2007), 95-100.

[2] Dai Yin-fei, Li Nian-feng, Zong Ying-yong. Discussing On RFID Tag Conflict Problem. International Journal of Multimedia and Ubiquitous Engineering. (2015), 333-342.

[3] LEE S R, JOO S D, LEE C W. An enhanced dynamic framed slotted ALOHA algorithm for RFID tag identifica-tion. The Second Annual International Conference on Mo-bileand Ubiquitous Systems: Networking and Services, (2005).

[4] Dai Yin-fei, Liu Ming-hui. Research on Several Multicast Routing Algorithms. International Journal of Smart Home, (2015).

[5] Zhang Xiaopeng, Li Jianmin, Lin Zhenrong. The complex event processing technology in RFID Middleware Research (J) micro computer information, (2009), 25(9-2): 145-147.

[6] Christian Floerkemeier. Transmission control scheme for fast RFID object identification [A]. IEEE PerCom Workshop on Pervasive Wireless Networking, Italy, March (2006).

[7] Su-RyunLee, Sung-DonJoo, Chae-WooLee. An Enhanced Dynamic Framed Slotted ALOHA Algorithm for RFID Tag Identification [A]. Proceedings of the Second Annual International Conference on Mobile and Ubiquitous Systems: Networking and Services, San Diego, CA, USA, July (2005).

[8] Inwhee Joe, Juno Lee. A Novel Anti-Collision Algorithm with Optimal Frame Size for RFID System [A]. 2007. SERA 2007. 5th ACIS International Conference, (2007).

[9] Gu Yu, in Ge, Zhang Tiancheng. RFID complex event processing (J). Computer science and exploration, (2007), 1(3): 255-267.

[10] Qiaoling Tong, Xuecheng Zou, Dongsheng Liu,et al. Modeling the Anti-collision Process of RFID System by Markov Chain [A]. Wireless Communications, Networking and Mobile Computing, 2007. WiCom (2007).

[11] Complex event processing (J) in large-scale RFID in data communication. Control and instruments in chemical industry, (2009), 36(4): 76-79.

[12] Yin Fangming, Kang Muning, Chen Qun, et al. The limited memory RFID (J) complex optimization algorithm based on the research and application of computer processing events, (2009), 26(8): 2864-2867.

[13] Zhao Li. (D) the design and implementation of event management system in RFID middleware. Wuhan: Huazhong University of Science and Technology, (2006).