The Application of RFID Technology in the Logistics Supply Chain

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Abstract—Based on the RFID (radio frequency identification) technology features, the paper make a deep analysis of the RFID technology effect on all aspects of the logistics supply chain management to make it achieve synergy and optimization, and proposed information sharing and security protocols for the exchange of information in the supply chain management process.

Keywords: RFID, protocols, Logistics Supply Chain

I. INTRODUCTION

RFID (Radio Frequency Identification) technology, is a non-contact automatic identification technology, through radio frequency signals automatic identifies target audience and get relevant data. RFID technology has been successfully applied to many areas in developed countries such as Europe and the United States. U.S. Food and Drug Administration (FDA) recommended pharmaceutical companies from 2006 onwards, all retroactive to use RFID technology to track suspected drug. British Marks Spence supermarket use RFID to manage the fresh food supply chain, make an effective guarantee to the food quality and safety. Australia use electronic ear tags in the cattle dairy exports quarantine to China to achieve quarantine regulation. North America's largest food service marketing and distribution organization SYSCO has completed low-temperature storage and transportation systems RFID and sensor system testing. In order to promote the application of RFID technology China's Science and Technology specially set up RFID (863) Special in the "Eleventh Five-Year" period. 863 plans have made the application of RFID technology in the area of supply chain management and logistics as an important project to concern. In China RFID technology is mainly used in automated highway toll collection, Bus E-Pass System, personnel identification and materials tracking, production line automation control, warehouse management, vehicle anti-theft system, rail vehicles and freight containers for identification and so on.

II. RFID TECHNOLOGY WORKING PRINCIPLE AND FEATURES

Reader sends a certain frequency RF signals through the transmitting antenna. When the label into the launch area induced current generated, the label gain energy and is activated, send its own coding and other information to the reader. Reader demodulation and decoding after receives the carrier signal, and then sent to the background information network system for processing. System identifies the code which identifies the objects information, and make disposal in accordance with the requirements of the system, to achieve manage and monitoring the goods.

Compare with other automatic identification technology (Bar-code technology, optics and biometric identification technologies, including iris, face, voice and fingerprint) RFID technology with the advantages such as anti-interference ability, informative, non-visual ranges of literacy long life and so on. RFID technology waterproof, anti-magnetic, high temperature, long service life, reading distance, tag data can be encrypted, data storage capacity, store information can be changed freely, identifiable high-speed moving objects, fast simultaneously multiple labels at one time and convenient operation. Its application brings revolutionary changes to the logistics, retail and other industries. RFID systems are generally made up of four components, electronic tags, reader, RFID middleware and RFID application system software.

III. THE LIGHTWEIGHT SECURE AUTHENTICATION PROTOCOL IN THE RFID IDENTIFICATION

Representative lightweight safety certification agreement including: Strong Authentication and strong Integrity Protocol (SASI) and Two-Message Mutual Authentication Protocol (TZMAP).

A. SASI protocol

SASI protocol using a simple XOR, shift, and with operations, instead of complex encryption algorithms which greatly simplifies the production costs of the label and meet the design requirements of low-cost RFID systems. The Protocol regulates: the tag and reader share the key $k_1$, $k_2$ and the pseudonym IDS before the certification, use the pseudonym IDS to replace the true ID and continuously updated in the process of the certification. Figure 2.1 describes the SASI protocol certification process.

The implementation of the protocol process as follows:
1) Reader sends Query authentication requests to the tag.
2) The reader of the tag sends pseudonym IDS.
3) According the pseudonym IDS reader finds the corresponding key $k_1$, $k_2$, produce random numbers $n_1$ and $n_2$, separate calculate $A$, $B$, $\bar{k}_1$, $\bar{k}_2$ and $C$ in...
accordance with the diagram formula and send the $A || B || C$ to the tag at the same time.

4) The label calculates $n_1$ and $n_2$ from A and B, re-calculate $k_1$ and $k_2$ and gets C. Compare of whether the receipt C and calculated C is consistent, if so then complete the certification of the label to the reader. And calculate D, send it to the reader.

5) The reader compare the received D and its own calculate D, if they are consistent then the reader complete the certification to the label, whereas the authentication fails.

6) According to $IDS = (IDS + IS) \oplus (n_1 + k_1)$ and $k_1 = f_k(x_1 \oplus n_1)$, updating the pseudonym and key.

Use SASI protocol the hardware circuit of the label can be reduced to about 300 logic gates, fully meet the low-cost design requirements of systems while relatively safe design of the protocol, which can resistant to several common attack methods with the better features such as forward safety characteristic, dual-phase authentication and key update function.

B. T2MAP protocol

T2MAP protocol (Selma, 2006) requires only two messages using the smallest number of messages in all of the RFID protocols. Although the protocol only use two messages, but achieved a two-phase authentication. The protocol regulates save each other corresponding label ID and key in the memory of the label and the reader device. Figure 2.2 describes the certification process of T2MAP protocol.

The implementation of the protocol process as follows:

1) Reader sends authentication requests to the label and randomly selects two lists $ID_2, ID_1$, from the memory ID sequence and send to the label.

2) Label find whether there is have the same $ID_2, ID_1$ in its own memory ID sequence, if it does, then finish the label to the reader certification.

3) The label make a simply encrypt (You can use the most simple Single-XOR) to the encryption $key_1, key_2$ that correspond with $ID_2, ID_1$, then transmitted to the reader.

4) The reader will make a comparison between the received $f(key_1, key_2)$ and the calculated $f(key_1, key_2)$, if they are consistent then the reader complete the certification to the label.

IV. THE INTEGRATION OF RFID TECHNOLOGY AND SUPPLY CHAIN

Widespread use of RFID technology in the logistics can achieve intelligent of the whole supply chain including the production, storage, transportation and sale.

A. The application of RFID technology in manufacturing

The application of RFID technology in manufacturing sectors can complete the operation of automated production lines, identify and tracking to raw materials, components, semi-finished and finished product in the whole production line, reduce labor identification costs and error rate, improve efficiency and effectiveness. RFID adapt to a single variety of logistics target object. As for the logistics of this single variety of different material characteristics of the object, need to adopt different frequency RFID systems to identify. The information contained in RFID tags can be first read in the processing link, product processing enterprises can write the necessary information such as technology for the integrative processing, the stands of relevant competent departments which including the date of processing unit, processing date, additives used in processing, packaging weight into electronic tag. The origin of information and the processing information have been stored in the electronic tag after the data of processing enterprise be enriched. Then the end-consumers in retail or wholesale through query terminals inquiry the information of the product they can be readily perceived its related information. Make the product quality and safety of transparency, the accident trace become easy and possible.

B. The application of RFID technology in warehousing of goods

The enterprise can control of the commodities inventory information in real time to learn about demand patterns of each commodity, timely replenishment, thereby improving inventory management, reduced inventory levels through apply RFID in inventory management.

C. The application of RFID technology in goods Transmission

The transportation management that based on RFID technology can quickly and easily tracks and control of goods, allows companies to direct knowledge of the current number of containers in the transport, the origin and destination of transit, as well as the expected arrival times and other information. To facilitate the management of in
transit goods, facilitate shipper and the consignee control of goods moving state and adjust the time of receipt accordingly.

D. The application of RFID technology in goods delivery process

RFID technology in distribution links can greatly accelerate the speed of delivery and improve the process of selection and distribution efficiency and accuracy reduce human workload, reduce distribution costs.

E. The application of RFID technology in goods sales link

Based on RFID technology distribution channel management, can be more systematic and reliable to monitor the goods. Improve the retailer's inventory management standards, achieve timely replenishment, efficient tracking transportation and inventory, improve efficiency, reduce error rate, eliminating the need of manual intervention to track the process, and can generate 100% accurate business data, which have enormous attraction.

V. THE ROLE OF RFID TECHNOLOGY ON SUPPLY CHAIN

RFID technology optimizes the supply chain which provides a new business mode of operation for supply chain participants. As a high-tech information technology, its fast, real-time, accurate collection features fully demonstrated its great value to the field of logistics management, mainly manifested in the following aspects:

A. Speed up the identification of goods

Place reader out of the warehouse distribution centers mouth, use forklift trucks to carry goods into the warehouse when the goods in and out storage, without the need to stop to scan at the entrance, capture date in the process. Readers can long-range, dynamic, identify of multiple tags. Some card readers can read the date of 200 tags per second which is 1000 times faster than traditional scanning, saving shipment, accident handling and so on labor resources.

B. Transmits information more quickly and accurately, improving the quality of inventory operations

RFID reader can automatically obtain all the information on the label, using PC machine check the inventory records. The use of RFID technology will significantly reduce the omissions and other errors in the traditional inventory check, enhance the information accuracy and dependability.

C. Improve the meticulous management

Adoption of RFID technology can effectively reduce the jumbled of information and facilitate develop sophisticated information-oriented management approach.

D. Logistics tracking

The core of the RFID technology is that the EPC (Electronic Product Code) on the label provides unique identification of physical objects. Through the combine of the computer technology, network technology, database technologies, the use of EPC allows logistics tracking and supply chain automation management in the whole goods supply chain, enhance transparency of supply chain management degree.

E. Anti-counterfeit

Use RFID technology can tracking product the goods throughout the process, has a complete history for each product. The modifications to the product label only can be carried out by authorized manufacture.

F. Enhance the scope of information sharing

Increase the exchange knowledge and information channels between core business and supply chain partners, promote the coordination of supply chain information-sharing capability, and enhance the accuracy of the customer demand forecasting.

VI. CONCLUSION

RFID technology has become a supporting technology in the supply chain management which plays a large role. Its application will save labor costs, improve logistics efficiency and makes effective tracking of logistics, expand the scope of sharing information resources of logistics. It will have a significant impact to the development of logistics and logistics standards as the RFID technology continues to mature.

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