Abstract—Through the study of the Internet of Things technology, the idea combining EPC Internet of Things with WSN is proposed which demonstrates the integration feasibility of the RFID and WSN technology. In order to improve the efficiency of logistics enterprises all aspects in the transport process should be monitored which need to apply the Internet of Things technology into the logistics management system. The logistics information is obtained by radio frequency identification, sensors, etc., is transferred by network which combines the Internet, mobile communication network and other network information transmission, and is analyzed and processed through the logistics management system. In this way functions such as user management, vehicle management, site management, order management, distribution management and other functions are implemented effectively which can facilitate the remote operation and monitoring on the user information, vehicle information, order information inorder to intelligent decision-making and control.

Keywords- Logistic; Internet of things (IoT); Radio frequency identification (RFID);

I. INTRODUCTION

As the market economy system continuous improvement, logistics as an advanced organization and management techniques, is widely considered to be an important profits source in enterprise besides lowering the material consumption, improving labor productivity and play an important role in the national economic and social development. During the trade the logistics process of goods from manufacturers to end-users is existed objectively. In a long time, people never take an initiative, systematic and holistic consider on it, thus the system's overall advantage cannot work. As social and economic development and the advancement of technology, logistics information systems are developed on directions such as the information classification integration, the system functions modulation, online information collection, information stored in large-scale, information transmission on network, and information processing intelligently and information processing using graphical interface, and so on.

Intelligent logistics is based on a wide use of the internet of things. It makes use of the advanced information collection, information processing, information flow and information management technologies, and completes a number of basic activities through the whole moving process including the transportation, warehousing, distribution, packaging, loading and unloading. It can provide the maximize profits for the supply and provide the best service for the demand while consuming the least natural and social resources and maximizing the protection of the whole intelligence community logistics management system in the ecological environment.

II. THE INTERNET OF THINGS TECHNOLOGY

The concept of the Internet of things was made in 1999 which means the network connecting objects. It is defined as: Through the RFID (radio frequency identification), infrared sensors, global positioning systems, laser scanners and other information sensing device, one kind of network where things are connected to the Internet according to the agreed protocol for information exchange and communication in order to achieve intelligent identification, location tracking, monitoring and management. When discuss it the concept of M2M is often referred to. M2M can be interpreted as man to man, man to machine, machine to machine.

The Internet of things has an overall impression on the logistics industry. The Internet of things technology is a revolutionary innovation in information technology. The main line of development of modern logistics industry is based on information technology revolution. The Internet of things will bring intelligence to the logistics distribution network, agility and intelligence to the supply chain, bring transparency and real-time to the item management of the logistics system which realize traceable logistics management of important items.

The Internet of things will bring the logistics industry into the age of wisdom. The Internet of things is mainly applied in the logistics industry in the following four areas. First, the intelligent network system of products such as food traceability system, drugs traceability system, and etc. which can be traced back is established based on technologies as RFID. Second is the visual management network of smart distribution based on GPS satellite navigation. It is a real time and visualized online scheduling and management system about the logistics vehicle distribution. Third is based on sound, light, mechanical, electrical, mobile computing and other advanced technologies, a fully automated distribution center is established to achieve
intelligent logistics control in local area and network automation. Four is based on the intelligent goods dispatching the public information platform of logistics network is established.

A. The architecture of IoT

The IoT has been applied in a number of infrastructures. Because at this stage there is no uniform standard of the IoT, it must study already built applications and application examples of the IoT to do an in-depth study of its architecture. The most representative structure of the IoT is the Electronic Product Code (EPC) global Internet of things architecture supported by European and American which is shown in Figure 1.

![Figure 1. Architecture of IoT](#)

B. The Internet of things system based on EPC

Currently, the majority applications of the IoT are based on the EPC network of RFID. RFID is a non-contact automatic identification technology. It uses the radiofrequency electromagnetic waves through space coupling (alternating magnetic field or electromagnetic fields) to achieve non-contact transmission of information between the reader and the classified tractable moving objects (objects with RFID tags attached). By the message passed the identification purpose can be achieved.

The main components of the IoT system based on EPC include:

- EPC tags. EPC is a global digital identity of products stored in the label according to standard definition;
- The electronic tag reader. It is a device using radio frequency identification technology to read information stored within the electronics label and to transfer to the logistics management system;
- EPC middleware. It is a set of program modules or services with special attributes. A user can customize and integrate different functional parts in the EPC middleware according some application demands. The most important component is the ALE (application layer events), which is used to handle events related to the application layer;
- EPC Information Service (EPC-IS). It consists of two functions that dealing with information stored in EPC middleware and querying relevant information;
- Object Naming Service ONS (objects name service). Similar to the domain name server, the information in it can be used to point to an EPC-IS server which stores the EPC middleware information.

The architecture of the IoT system based on EPC is shown in Figure 2.

![Figure 2. The architecture of the IoT system based on EPC](#)

III. NETWORK STRUCTURE OF THE LOGISTICS MANAGEMENT SYSTEM

A. Wireless Sensor Network WSN

The WSN (wireless sensor network) is composed by a large number of tiny sensor nodes deployed in the monitor region which through the wireless communication manner to form a multi-hop ad hoc network system. It aims to collaboratively apperceive, gather and process the information of perceived objects in the network coverage area and then sent to the distribution management center.

Currently, the study of the IoT is not yet in-depth and its technical content also lacks professional research. The wireless sensor networks WSN and the IoT are often be confused in a number of professional and non-professional reports. In our country the IoT is usually called the sensor network but it is not the same as the wireless sensor network. View from the network architecture and protocols, they are completely different. View from the target feature, IoT tests and connects known materials but the WSN detects and apperceives the unknown materials or parameters. However they are inseparable. The RFID technology is one of the core technologies of the IoT. The RF ID module in the IoT can be
integrated with the sensor technology or be combined with WSN for complementation in order to gain experienced environmental parameters in the logistics process such as the temperature and humidity. And using WSN it can transfer data by RFID reader to weaken the WSN’s sensor function. In some WSN extension applications, RFID agreement can also be one of the wireless communication protocol or to detect properties of known objects. For mobile readers in handheld devices, a dedicated wireless network should be built. But for logistics management system based on WSN (such as ZigBee technology), the node cost is higher than the EPC’s and the node size is not truly miniature, thus it cannot be attached to the surface as the same as the label does which the have a great impact on the movement of goods.

B. WSN and EPC

EPC-based logistics management system can be combined with WSN. The combined system uses the WSN to transmit data for EPC system and to track and monitor logistics. WSN is an effective complement to the EPC system which has great advantages to do data transmission in EPC system. It reduces wiring costs caused by the cable transmission of EPC reader and the operation interference caused by wiring. So a single network can achieve data transfer. If the reader uses a wired network for data transmission then for mobile reader a dedicated wireless network is also needed to be set up which increases the system complexity and cost. The WSN has unparalleled advantages on the environmental monitoring and its application is more mature. On this stage, the cost of WSN nodes is lower and the network stability and data reliability has greatly improved. Therefore, the EPC system should be combined with the WSN.

IV. LOGISTICS MANAGEMENT SYSTEM

A. System Design

In each order process, the reader first does data collection through the RFID technology. The goods information, goods spatial data and goods attribute data are sent out as the WSN node. The information accesses the database through the WSN. The database management system analyzes the data for decision support. The scheduling order issued gives the deployment of vehicles and path analysis. Through the electronic map, goods can be queried and updated. WSN's role in the system is data transmission and goods inspection, monitoring and positioning.

RFID readers have two kinds mobile and fixed. Mobile RFID readers are mainly installed in the handset for occasions without a fixed location. The using methods are similar to the bar code reader. The fixed readers are mainly installed in the in and out channel and the operating platform for automatic identification and tracking verification. Mobile RFID readers need to combines related equipment. And at the same time, the use of wireless sensor networks can ensure the real-time data transmission.

Readers combined with WSN nodes are not only to send the label information scanned by readers, but also send monitoring information. This kind of node with reader function should serve as the central node of WSN. In order to improve the reliability of WSN, the network is designed to the self-organizing network in mesh topology which avoids the case that data cannot be transferred caused by a central node failure resulting. Of course, the multi-sensor and multi-source information fusion in the WSN can reduce the network burden.

B. Detailed design of the system

In the logistics management system, the transport vehicle location is monitored in real-time. Once the vehicle fails to move along the scheduled routes or leave the route to pull private goods, etc., a warning will be given immediately. And the staff will contact the driver to do relate processing. Of course, the original transport route can be adjusted according to actual situation to improve transport efficiency and management efficiency.

Logistics management system includes hardware and software two parts. The software part is the logistics management system in major which includes user management, vehicle management, site management, order management, distribution management five modules. The hardware components are the various hardware devices and tools supporting the logistics management system.

The logistics management system issues the goods information to the Internet of Things. In the whole range of IoT, whether the user information, vehicle information, or order information can be easily operated and monitored remotely. Distribution management module includes querying orders to be sent, creating logistics, deleting logistics, managing logistics order management, sending and receiving logistics, querying logistics, choosing routing, vehicle scheduling and other functions.

- Querying orders to be sent: Before determination of the distribution proposal, inquiries orders to be sent according to the order’s sender address, the type of order and others.
- The creation of logistics: According to the order’s sender address and recipient address to create an appropriate number of logistics.
- Removing the logistics: According to the distribution proposal to delete inappropriate logistics.
- Managing orders in the logistics: Orders to be sent join into the appropriate logistics. And the logistics can also be adjusted by removing some of orders in one logistics.
- Sending and receiving logistics: During the goods transport, when the vehicle is starting from a site, the sent information is recorded; when the vehicle arrives at a site, the received information is recorded.
- Arrange for the vehicle: According to the cargo’s volume and weight, and the condition of the vehicles which can be scheduled suitable vehicles are arranged for the logistics.
• Select the path: According to the logistics starting and terminal stations, using network analysis to select the most appropriate path to meet the conditions.

• Querying logistics Information: Querying logistics information based on the number of logistics, starting points and terminals and others.

• Logistics tracking: There are two ways for logistics tracking. One is tracking based on the past stations and displaying in the text. Another is tracking based on where is the vehicle real-time location and displaying in visualized maps.

• Querying the transportation path: Customers can view the goods transport path according to order number which is shown on the map.

V. CONCLUSION

This article describes the application of IoT in logistics management systems. The global structured IoT based on the EPC and its application in the logistics system has been studied and analyzed. Moreover one view the combination of IoT based on EPC and WSN for complementary application is proposed. And also discussed the feasibility of integrating RFID and WSN technology and logistics management applications’ advantages and business detailed design are discussed. Through the analysis and research, it can be found that the application prospect of IoT is bright which will bring changes to our production and life. But it also can be seen that IoT is still in the initial application stage and some problems should be researched to fully meet the requirements of intelligent logistics management system such as technical standards, network architecture and protocols, security issues, terminal issues and so on technology issues.

REFERENCES


