

# Research on the Architecture and Application Schema of Cloud Warehousing Mode

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**Abstract**—In recent years, collaborative warehouse is becoming a new trend of the warehousing industry. This paper aims to build a cloud warehousing system consists of information system and operating system, based on internet of things, cloud computing, control technology and communication technology. The system can achieve information collection, high-precision simulation, intelligent control, real-time computing and other functions. This Paper firstly introduced the research background and the architecture of cloud warehousing system, then analysed its application schema, finally analysed the advantages of cloud warehousing mode and point out the challenges will be faced with in practice.

**Keywords**—cloud warehousing system; cloud computing; internet of things; communication technology; control Technology

## I. INTRODUCTION

Over the past decade, the logistics industry in China has gone through a period of rapid development. Warehouse is the core of logistics, but problems such as low usage rate, low inventory accuracy and other issues is becoming the bottleneck of traditional warehousing industry. Therefore, the efficiently use of warehouse resources has become the key of the warehouse management innovation.

Because information technology and automation technology has widely used in some traditional warehouses. Recently, the relevant research hotspots are mostly focused on the construction of intelligent warehouse. However, previous studies generally involves in a single enterprise, the study of joint warehousing mode is rare. In order to integrate the information and resource of warehouses, this paper proposes a cloud warehousing mode based on the existing warehouse systems. This mode is comprehensively use Internet technology, sensor technology, communication technology, intelligent control and other related technologies based on Internet of things. Cloud warehousing system should have global information collection, transmission, processing, inquiry and intelligent decision-making and control functions, and should be able to achieve automatic mapping between physical system and virtual simulation system. This paper introduces the research background, the components and the technical architecture of cloud warehousing system, then analyses the cloud warehousing application schema. Finally, the paper analysis the advantages of cloud warehousing mode with respect to traditional warehousing modes, then point out the problems that will be encountered in practice and put forward corresponding reference proposal.

## II. THE RESEARCH BACKGROUND OF CLOUD WAREHOUSING MODE

### A. Development Status of Warehousing Industry

In China, There are over 50% logistics enterprises, 73% manufacturers and 36% business enterprises own independent warehouses. Problems as low usage rate and inventory backlog are widespread. The main cause of these problems is the lack of collaboration. Enterprises control inventory independently will occlude the information sharing, and lead to small coverage and low inventory accuracy rate of each warehouse. These problems will make the demand of warehouse resources be magnified, then cause excessive construction, and eventually cause high cost, low usage, low efficiency and poor quality in traditional warehouse.

### B. The Basis of the Research

In order to improve the level of collaboration, many warehouse enterprises formed coalitions, many enterprises outsourced warehousing business. These attempts have achieved joint warehousing to some extent. Integration of logistics have a lot of successful cases, the joint use of warehouses is becoming popular.

1) *Technical basis of cloud warehousing mode*: Because of the major strategic significance of the Internet of Things on science and technology and economic development, Western countries have listed it as a key project in the field of science [1]. China also attached great importance to the study of the IoT and has accumulated certain foundation on technology, standards, industrial training and applications. Moreover, cloud computing technology has massive data processing capacity, will improve the response speed to meet the needs of data processing. These technologies laid a solid foundation for the study and application of cloud warehousing mode.

2) *Policy support for cloud warehousing*: "The informatization and industrialization depth fusion special action plan (2013-2018)" noted that we should fully promote the integration of next generation Internet, mobile IoT and cloud computing. "The Internet of things development special fund project 2013" regarded the construction of intelligent management system based on IoT as one of the key funding projects, aimed to designed a public logistics service platform

cross regional, industry and sector, and to improve efficiency, security and controllability of logistics [2].

### III. SYSTEM ARCHITECTURE

#### A. Definition of Cloud Warehousing Mode

Cloud Warehousing Mode refers to several enterprises share their warehouse information and resources to form a comprehensive intelligent system based on cloud computing and Internet of Things. Mainly include information collection system, communication system, cloud computing system, control system and operation system. The architecture is shown in Figure 1.

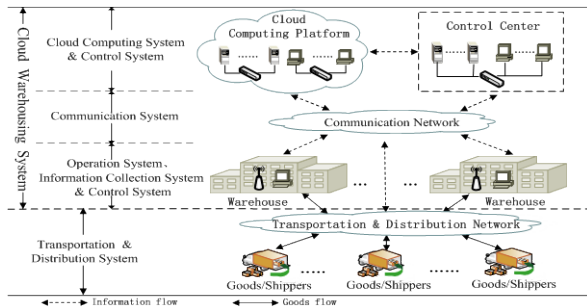


FIGURE I. THE ARCHITECTURE OF CLOUD WAREHOUSING SYSTEM.

#### B. Components of Cloud Warehousing System

Cloud warehousing system mainly based on Internet of things, IoT have control and computing functions itself. Since massive data processing and control technology is the key of cloud warehousing system's implement efficiently, there listed cloud computing platform, control center and control terminals separately.

1) *Internet of things (IoT)*: The concept of IoT was clearly articulated by ITU in the Internet report 2005. Since there is no uniform definition of IoT, it can be defined as follow from application perspective, IoT is defined as a three-dimensional system of information things, autonomous network and intelligent applications [3]. In the cloud warehousing system, the above three dimensions respectively refers to:

1. Information things mainly refer to: the goods with electronic tags.

2. Autonomous network refer to: a self-organizing communication network can connect goods, information collection devices, control terminals and control center. And it mainly used to transfer data and control instructions.

3. Intelligent applications refer to: formulate optimal warehousing scheme, integrate cargo space and monitor environment intelligently. In addition, it should also meet the personalized demand of customers.

2) *Cloud computing platform*: Cloud computing platform consists of cloud computing center and cloud data center. According to the definition by NIST, cloud computing is a calculation mode which can achieve easy access to a shared

computing resource pool anywhere, anytime, on-demand via the Internet [4].

Cloud warehousing systems needs to process massive information, the amount of data is likely to face even higher level reached PB. The system adopts cloud computing mode mainly has the following advantages [5].

1. Cloud computing platform has effective data management technology, can quickly and accurately analysis and process the massive heterogeneous data.

2. Cloud computing mode has strong scalability, can quickly adapt to the expansion of system scale and order form volume.

3. Cloud computing mode has the ubiquitous access characteristic. Clients call cloud computing services through communication network at anywhere and anytime, can reduce the hardware cost of the system.

3) *Control center*: Control Center is an information feedback bridge between management system and operating system. To reduce the load of control center and do decentralize control, cloud warehousing system set up a control terminal in each warehouse.

Control terminals used to establish a simulation system according to the collected real-time information; analyze and execute instructions issued by the control center; exchange data with cloud computing platform; query, process and update the data, realize synchronism between warehouse status and data center.

Control center is used to connect warehouses into a complete system. The main functions include: build global simulation system according to the information submitted by control terminals; call calculating functions from cloud computing platform; make overall decision and send instructions to the control terminals.

#### C. Technical Structure of Cloud Warehousing System

From application perspective, cloud warehousing mode is mainly based on the following key technologies.

1) *Massive Information Collection Technology*: In order to ensure consistent and accurate mapping between information system and physical system, cloud warehousing system must have the ability to quickly and accurately collect and process various types of heterogeneous information. Mainly adopt RFID technology and wireless sensor networks (WSN).

##### RFID technology

All the goods in the system are adhered electronic tag with electronic product code (EPC), in which stored number, name, weight, size, type and destination information of goods. RFID technology uses radio frequency signals for automatic identification and information collection. And RFID technology can also be used for location tracking [6].

##### Wireless Sensor Networks (WSN)

The node of traditional WSN has not yet achieved miniaturization and costly, so there use RFID readers and

other sensing devices act as WSN nodes. And weaken the sensing function of WSN.

2) *Massive information processing technology*: Traditional centralized computing mode can't meet the need of massive distributed heterogeneous data processing in the cloud warehousing systems. Cloud computing technology has real-time massive data processing capabilities, and software as a service (SaaS) mode can provide users with convenient data query and processing services according to their requests.

3) *Automatic mapping technology*: Cloud warehousing system collect information to form a real-time status in the control terminals, feedback the status to data center via the communication networks, then create a virtual simulation system in cloud computing platform, and then generate control instructions in control center according to the virtual images. Meanwhile, according to dynamic statuses, cloud computing center will constantly modify simulation system to improve the simulation accuracy, thus to strengthen the virtual simulation system's ability to control physical system.

#### IV. APPLICATION SCHEMA ANALYSIS

##### A. The Key Factors of the Optimization Algorithm

Formulate an efficient warehousing scheme is the key to the success of cloud warehousing mode. Only to design a reasonable and effective algorithm, can advantages be reflected compared with the traditional warehousing mode. Following key factors always be considered in the selection algorithm.

(1) Cost. Including transport costs, warehousing costs and management costs, optimal warehousing scheme request a minimum total cost.

(2) The specific of warehouse. Such as cold warehouse can only store some particular types of goods.

(3) The nature of warehousing orders. Such as a manufacturer select specific warehouses due to technical confidentiality or other reasons.

We should comprehensively consider a variety of factors in algorithm design to balance the interests of all parties and encourage the enthusiasm to cooperate.

##### B. Application Schema

The operation mode of cloud warehousing system is obviously superior to the mode of traditional independent warehousing, since the cloud warehousing mode can achieve the global optimum. The operation procedures of the two warehousing modes are respectively shown in Figure 2 and Figure 3.

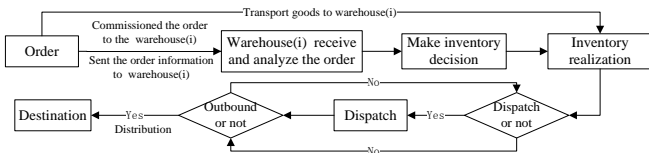


FIGURE II. THE OPERATION PROCEDURES OF TRADITIONAL WAREHOUSING MODE

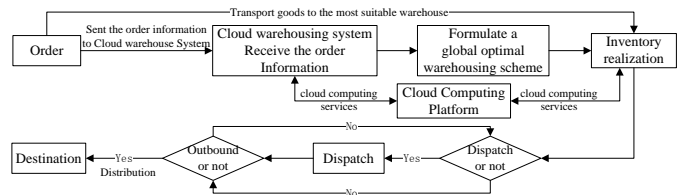


FIGURE III. THE OPERATION PROCEDURES OF CLOUD WAREHOUSING MODE.

#### V. ADVANTAGES AND CHALLENGES

##### A. Advantages of Cloud Warehousing Mode

As the application schema of traditional and cloud warehousing mode shown in Figure 2 and Figure 3, compared with the traditional independent warehouse systems, the cloud warehousing system mainly has the following features:

(1) Can formulate a global optimum warehousing scheme, can reduce costs while improve warehouse efficiency.

(2) Information and resource sharing can improve the level of management and service, thereby increasing the system's overall competitiveness.

(3) Cloud warehousing system is easy to maintain and easy to expand, new-join warehouses only need to configure and manage according to the standard.

##### B. Challenges will be Faced with in Practice

Although cloud warehousing system with advantages as high intelligence, high-precision, high efficiency and low cost, but there are also exist some challenges in the implementation process will hinder the application and penetration of cloud warehousing mode.

1. Some core technologies and standardization need to breakthrough.

2. High initial construction investment. This issue heightened the join-in threshold of enterprises.

3. The formulation of profit distribution scheme is difficult. The viewpoints of single distribution schemes are different, so it is difficult to take the interests of all parties into account. So we should synthesize a variety of factors, and apply different distribution scheme due to the different nature of the order.

4. The weak Industrial foundation. Only to base on joint logistics, can cloud warehousing system to play stronger advantages. However, the operation mode is so different between logistics enterprises that it is hard to form a coalition. Therefore, in order to build an overall cloud logistics system, focus on training joint transport and distribution enterprises is imminent.

#### VI. CONCLUSION

Cloud warehousing system is a comprehensive warehouse management system consists of information system and operating system by mutual composition. The system can achieve information collection, real-time computing, high-precision simulation and intelligent control, based on the integrated usage of cloud computing, networking, communication and control technologies. Cloud warehousing

mode has quickly and accurately decision-making capacity compares with the traditional warehousing modes, and it can formulate warehousing schemes with lower-cost, higher efficiency, and can provide consumers with higher-quality warehousing services. Despite confronted with many challenges in practice, the application of cloud warehousing mode is becoming the new trend of warehousing industry.

#### ACKNOWLEDGEMENT

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