Large Data Exchange Based on the Internet of Things

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Abstract — Internet of things is known as the third wave of information industry after the computer and the Internet, but the study of the Internet of things is still in its infancy nowadays and there are still many challenges in the development and popularization of the Internet of things. It believes that massive data interaction mechanism of the Internet of things has a great significance to the development and popularization of the Internet of things. Under this assumption, the large data exchange based on the Internet of things is studied in this paper. It describes the key technologies of the Internet of things in detail following a brief introduction of the development status quo and the existing problems of the Internet of things, then it presents the architecture of the Internet of things, conducts deep research regarding the mechanism of large data exchange, and finally it proposes the integrated design of data fast interactive platform. The experimental results prove the effectiveness of the model. Fast data exchange platform breaks through the traditional where the server acts as the center of data exchange mechanism.

Keywords - The Internet of things; Large Date; IOT Architecture; Data Exchange Mechanism

I. INTRODUCTION

The Internet of things has highly integrated a variety of new technologies today, such as communication technology, materials technology, electronic technology, automation technology and other related channels and shifts the communication among people into people and things and things and objects. Because the Internet of things can provide ubiquitous links and security controllable and even various functions, like personalized real-time monitoring, scheduling command, alarm linkage, positioning and traceability management, it can achieve high efficiency and safety in environmental protection, energy saving and controlling, and provide integrated services. It is called the third wave of information industry after the computer, Internet and mobile communication network. Internationally, IOT started earlier in the United States, Europe, Japan and South Korea and a few other countries. Smart objects as building blocks for the internet of things was researched by Kortuem [1]. Sun summarized the concepts, architecture and key technology problem of the Internet of things [2]. Miorandi raised the vision, applications and research challenges of the Internet of things [3]. Riggins proposed the research directions on the adoption, usage, and impact of the Internet of Things through the use of big data in 2015 [4]. Later Bughin put forward the executive’s guide to the Internet of things [5]. In China, the Chinese Academy of Sciences began work on sensor network since 1999 and it has made important progress in many fields of sensor network. No doubt the current development of the Internet of things has reached the stage of implementation national wide. The technology and application of strategy of IOT were studied, and the definition, networking architecture, heterogeneous network layer, and networking and terminal node of IOT were discussed. Yan Ping designed the IOT intelligent system based on Home Furnishing in 2012 [6], and Chen propsed a comparative study of IOT architecture and implementation method in 2013 [7]. There are many definitions of Internet of things, but at present, it is generally accepted as the information sensing devices such as RFID tags, wireless sensors, intelligent terminals, etc. According to the transmission protocol, for connecting any item to the Internet, in a wired or wireless way, it would use "cloud computing" and other supporting technology for information exchange and other processing. in order to achieve intelligent identification, management, tracking and positioning functions such as a network. The remainder of this paper is organized as follows. Section 2 describes the related theories and key technologies. Section 3 gives the large data exchange based on the internet of things. Section 4 presents a real experiment to evaluate the platform. Finally conclusion is summarized in Section 5.

II. STATE OF THE ART

A. Internet of Things

The concept of the Internet of things was first put forward by professor Ashton from Massachusetts Institute of Technology Auto-ID laboratory during his study of RFID in 1999. At that time, the idea was that based on the wireless sensor network, RFID technology can be used to connect all the items with the Internet to achieve intelligent identification and management of the huge network through the information sensing devices. In the same year, Gershenfeld Neil professor of MIT published his book "When Things Start to Think", which marked the beginning of the development of the Internet of things. As Tveito argued that Internet of things has bright future prospects and a great significance to enhance the level of information
technology in the whole country through its social and economic development [8]. The Chinese government attaches great importance to the development and application of Internet of things, and even puts the development of internet of things into the country's overall information technology strategy. Nowadays, Internet of things has become an important part of the information industry in China. The concept of the Internet of things (IOT) was first proposed in 1999, and the idea is to connect all items with the Internet through the sensing equipment, so as to achieve the intelligent management. The combination of the Internet of things and the continuous development of information technology plays an unexpected role in all walks of life. For example, the sensor or the induction device is arranged or embedded into the highways, railways, bridges, tunnels, power grids, water supply system, dams, oil and gas pipelines and other facilities. Then the Internet of things will carry out the integration with the Internet through a wired or wireless signal, so that people can easily control the entire physical system. After the integration, a powerful intelligent computer, which can realize real-time monitoring of equipment and personnel, is needed. By this method, it can achieve the real-time, dynamic and meticulous management, so as to improve the environment control and the utilization rate of resources of human beings. The intelligent life system based on the IOT technology is a set of advanced technologies, with the micro chips embedded to the activities of daily life. Because of the wireless communication ability and perceived ability of the device nodes it builds an intelligent environment that has strong computing ability and adaptability. Users can receive all kinds of information, topology and wireless information through the calculation all the time. It can also use the existing Agent technology to carry on the autonomous learning, and intelligently control various electrical appliances for users based on user habits, so as to create a comfortable environment. With the improvement of living standards of users, intelligent life system will carry on constant upgrades in its own version to meet higher requirements.

Figure 1 Large data exchange based on IOT

The International Telecommunication Union (ITU) reports that four key technologies of IOT include radio frequency identification technology (RFID), sensor technology, nanotechnology, and intelligent technology. RFID is also known as the first of the top four technologies, and is the core and foundation of IOT.

Radio frequency identification technology (RFID) RFID is an advanced automatic identification technology, which can be used to carry on the full duplex data communication through the non-contact radio frequency, so as to achieve the real target recognition. As the most promising application technology, RFID not only shows strong application advantages in the field of logistics, but also has broad development prospects in commercial, transportation, medical, military and other fields. RFID has the features of fast reading, long distance and long-term tracking and management, and it is considered to be one of the most promising information technologies in twenty-first century. Compared with bar code, RFID performs better in the aspects of tag information capacity, reading capacity, reading distance, read and write update, environment adaptability and others.

Sensing technology Sensing technology is a multidisciplinary modern science and engineering technology through which the information obtained from the natural information source is processed and recognized. It relates to the sensor, information processing and recognition technology. The sensor technology, computer technology and communication technology are known as the three pillars of information technology. For the IOT, sensor technology is crucial for acquisition and processing of the information in the Internet of things. The sensor is the device or apparatus that can be measured on the basis of certain rules and can be used to convert the signal, which is usually composed of sensitive components and conversion components. Information processing mainly refers to changing the collected information, and the amount of information will not increase in the process of information processing. Recognition technology is mainly to identify and classify the processed information. Recently, four British universities spearheaded a smart sensor system research to further study the intelligence and stability of the sensor system, so as to explore its future application in the area of smart city, big data and automatic driving.

Embedded intelligent technology The embedded intelligent agent technology is the combination of the intelligent agent and embedded software, and it gives full play to the advantages of these two elements, so as to improve the performance of the whole system. The application of embedded intelligent technology is very extensive, such as intelligent home furnishing, intelligent transportation, and intelligent vehicle navigation system and others. The development of embedded intelligent technology is based on the Internet. It can safe and rapidly carry on the exchange of information with the outside world. In the Internet of things, the intelligence of items can be realized through the embedded intelligent
technology, so as to enable the items exchange information with people or machines.

Nanotechnology
Nanotechnology is a new type of high technologies that can operate among small objects within 0.1 ~ 100nm. Nanotechnology is not the proprietary technology of the Internet of things, and bio chip and biological sensor can be attributed to the nanotechnology. Nanotechnology can decrease the size of sensor, but improve its accuracy, and thus it can greatly improve the performance of the sensor.

B. Internet of things Architecture
The architecture of the Internet of things is the basis of understanding the Internet of things. It has the function of guiding the design of the specific system, which determines the technical details, the difficulty of the implementation of the specific application, and even its development trend [9]. Because of the heterogeneous nature of the Internet of things, it is necessary to ensure the architecture of the Internet of things to be open, hierarchical and scalable in order to enable the interconnection between heterogeneous information. From the system point of view, the Internet of things should have three functions of a comprehensive perception, data transmission, and intelligent processing [10]. Therefore, the Internet of things architecture in general can be composed of the following three layers: the comprehensive perception of the sensing layer, network layer for data transmission and application layer for intelligent processing. It is shown in the figure 2.

![Internet of things Architecture](image)

Perception layer is the basic element of the development of the Internet of things, including sensors, two-dimensional code, and a variety of data acquisition devices [11]. It is the gateway of data access before the data processing equipment and sensor network. It covers the collection of information about the physical world, automatic identification and intelligent control function. The network layer is the key element of the development of the Internet of things. It is established on the basis of the existing mobile communication network, Internet, and telecommunication network. And through various access devices and the existing networks connected, it achieves the two-way transmission and routing of the sensing data and control information. Application layer is the goal of the development of the Internet of things [12]. It can provide a variety of services through the analysis of the perceived data processing.

III. METHODOLOGY

A. Data Exchange Mechanism
Data exchange is mainly refers to the process of data packets, according to the Baotou Department of the data, to conduct the data packet forwarding or routing. The method
can realize the rapid data exchange include rapid exchange mechanism of data exchange devices and some other data.

B. Data Exchange Equipment

The current mainstream data exchange equipment mainly includes switches, routers and routing and switching equipments.

Switch
Second layer, the data link layer, switches work on the network. Its function is based on the two layer switching technology. The two layer switching technology is carried forward in accordance with the destination address of the received data frame, which is transparent to the network layer or the high level protocol. The switch in the data exchange is realized by hardware in high speed. But it cannot deal with data exchange between different subnets [13]. There is a forwarding table inside the switch. The table entry of the forwarding table reflects the correspondence between the host address and the switch port number on which the host is connected. It is shown in table 1.

<table>
<thead>
<tr>
<th>MAC address</th>
<th>Port number</th>
<th>Time mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-19-06-CB-45-12</td>
<td>FTP:20</td>
<td>05:00</td>
</tr>
<tr>
<td>00-E0-4C-F7-CD-A7</td>
<td>HTTP:80</td>
<td>12:13</td>
</tr>
<tr>
<td>00-01-02-03-04-05</td>
<td>TELNET:23</td>
<td>16:03</td>
</tr>
</tbody>
</table>

Router
The third layer network layer is network layer. The function of the router is based on the routing technology. Routing technology is essentially composed of the two most basic activities, which are determination the optimal routing and forwarding data packets. The router selects the best route based on the destination address of the packet, and then sends the packet to the next router which can reach the destination address. The next router which receives the packet continues to be forwarded in the same manner until the packet reaches the destination node.

C. Route Switching Equipment

The routing switching equipment can work at the data link layer and the network layer at the same time, and its function is based on the three layer switching technology. The three layer switching technology in the network layer is applied according to the destination address of the data packet fast routing, while in the data link layer it is in accordance with the destination address for the data of the fast exchange. As a result, the routing switching equipment is mainly composed of second layer switch module and third layer routing module, among which the second layer switching module is completely realized. The working principle of the routing switching equipment can be summarized as follows: the same subnet is switched, but the different sub networks are routed.

The communication environment is illustrated in the following diagram to present the detailed work process of the routing switch equipment when the two hosts are in different sub networks. It is shown in the figure 3.

From the figure, when the source host A sends the data frame, first of all, it will judge whether it is in the same VLAN as the host C. As the figure shows that the host C and A are located within the different VLAN.
D. Comprehensive Comparison of Three Types of Data Exchange Equipment

In the first type of data exchange equipment, the switch works on the second layer, which is based on the address to forward packets. Because during the implementation, the processing speed of the switch processing data packet is very fast, and there are multiple input and output ports, so it cannot handle the packet switching between different sub networks. It is only suitable for small networks.

In the second type of data exchange equipment, the router works on the third layer, which is based on the address to forward packets. Because the router can handle the packet switching between different sub networks, and there are multiple port types, it can achieve the interconnection between heterogeneous networks. But due to the parts of the system is based on the software implementation, and the packet processing process is complex, so packet forwarding efficiency, and speed is lower than switches. It is not very frequent that the router makes interconnection between large networks for data exchange..

In the third type of data exchange equipment, routing switching equipment can work at the level two or three, which has the function of routing and the performance of the switch. Compared to the switch, the routing switch can realize the packet switching between different sub networks. While compared to the router, the router switching device has the advantages of high number of ports, fast processing speed, and simple interface type and so on. In details, the advantages and disadvantages of the three data exchange equipments are shown in the table 2.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchboard</td>
<td>Based on ASIC implementation, processing speed, input/output port is low, low price</td>
<td>Does not handle the different sub network division of the data packet switching port, the price is low</td>
</tr>
<tr>
<td>Router</td>
<td>Handle the data packet switch between different sub networks, the port type is various, realize the interconnection between the heterogeneous network</td>
<td>Input/ output port little, the data packet processing process is complex, some functions are based on software implementation, the forwarding efficiency is low.</td>
</tr>
<tr>
<td>Route switching equipment</td>
<td>Handle the data packet switching between different sub networks, processing speed, simple interface type, excellent performance</td>
<td>Not very suitable for network topology and transmission protocol.</td>
</tr>
</tbody>
</table>

E. Fast Data Exchange Platform

Fast Data Interactive Platform Framework

The theoretical basis of the fast data exchange platform is the unified algebra theory. Algebraic logic operation is the function of the fast data exchange platform. Frame of fast data interactive platform based on chip set is shown in figure 4.

In the fast data interactive platform, the main control lies in ARM chip and FPGA chip, and while the data exchange function is realized by the FPGA chip. It is very simple for FPGA chip to realize the function of data exchange. After processing the data packet destination IP address, it follows custom logic algebra operation rules which are algebraic and logical operations, in order to get a signal output port, so as to realize the rapid exchange of data packets.
Integrated Design of Fast Data Interactive Platform

On the basis of the overall design of the data exchange module, the overall design of the data exchange platform is carried out. Overall design block diagram of FPGA data exchange module is shown in the figure 5.

![Figure 5 Overall design block diagram of FPGA data exchange module](image)

It is known from the framework of the fast data exchange platform that the fast data interactive platform is composed of a number of ARM chips and a number of FPGA chips. FPGA chip is the FPGA data exchange module. When a FPGA data exchange module is selected, it will extract the packet's destination IP address, and find the classification, followed by 2-band CT code and algebraic logic of 2-hexadecimal code, and finally get output port number. All FPGA data exchange modules in a data exchange platform can be operated completely in parallel, which can greatly speed up the processing of data packets.

IV. RESULT ANALYSIS AND DISCUSSION

This paper uses Load Runner to test the system and two different servers are used in the process of testing. The blue color represents the frequency of the 2.83GHz server and the red represents the frequency of 3GHz server. It uses the Load Runner to simulate different client user visiting the system, which carries on the concurrent access to the server, and therefore the number of requests of the server can be tested every second. The experimental results are shown as follows.

![Figure 6 Results of system test](image)

The experimental results show that the ability of the server program processing basically has a linear relationship with the number of clients. The more the number of client requests, the higher the failure rate of the corresponding.

V. CONCLUSION

As the most promising information technology in twenty-first century, Internet of things has shown great development potential and application prospects. However, the research of the Internet of things is still in its infancy, and there are still many challenges in the development and popularization of the Internet of things. Therefore, this paper studies the large data exchange platform based on the internet of things, analyzes the mechanism of large data exchange in depth through the architecture of the Internet of things, and finally proposes the integrated design of fast data interactive platform. The experimental results show the effectiveness of the model. Massive data interaction mechanism of Internet of things has a great significance for the development and popularization of the Internet of things. The data exchange network is mainly used for the fast exchange of the massive data of the Internet of things. Fast data exchange platform breaks through the traditional where the server works as the center of data exchange mechanism. Whether in theory or technology, it is a bold innovation for huge amounts of data fast interaction mechanism and the expansion of the network scale and application scope has certain practical significance.

REFERENCES


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