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BUSINESS INTELLIGENCE ARCHITECTURE BASED ON INTERNET OF THINGS

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ABSTRACT

On the basis of the analysis of the operating characteristics of new intelligent network - Internet of things, the paper holds that the combination of the Internet of things and cloud computing is the design to cope with massive data in the future. The core of business intelligence lies in data warehousing whose rich data source is offered by Internet of things and therefore its application ability is greatly expanded .The business intelligence architecture is put forward based on Internet of things.

Keywords: *Internet of Things(IOT），Cloud Computing, Business Intelligence (BI),Network architecture*

1.CONCEPT AND FEATURES OF THE INTERNET OF THINGS (IOT)

The Internet of Things (IOT) is a network that links and combines any identifiable object with the internet according to a certain protocol, while conducting information communication and exchange at the same time through a variety of information sensing devices, such as Radio Frequency Identification device (RFID), Infrared Ray Sensor, Global Positioning System (GPS), and laser scanner, etc., so that a series of intelligent operations, involving the identification, location, tracing, supervisory control and management of the object, can be achieved.

As a new network structure of the global information industry, the Internet of Things (IOT) typically possesses three characters: one is comprehensive perception, i.e. making use of all kinds of sensing means available to realize the acquisition of an object's dynamic state immediately at all times; another is reliable delivery, which means transmitting perceived information on a real-time basis precisely and reliably by integrating different kinds of information networks into the internet; the other is intelligent processing, an intelligent control of an object by conducting the analysis and processing of massive data and information with the help of intelligent computing technology, especially cloud computing.

The Internet of Things (IOT) is a global architecture which is open, distributed and dynamic. It can maximize the interoperability of existing or even potential heterogeneous systems and distributed resources, and become an essential technique that will promote industry development as well as the advancement of the whole society. Meanwhile, the digitalization of physical world will make the data quantity on the internet rise gradually. Therefore, the development of IOT will in return give rise to problems related to the data storage and intelligent processing of huge amounts of information.

The following are the key technology of the Internet of things:

1.1RFID

Radio-frequency identification (RFID) is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. Some tags require no battery and are powered and read at short ranges via magnetic fields (electromagnetic induction). Others use a local power source and emit radio waves (electromagnetic radiation at radio frequencies). The tag contains electronically stored information which may be read from up to several meters away. Unlike a bar code, the tag does not need to be within line of sight of the reader and may be embedded in the tracked object.

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RFID tags are used in many industries. An RFID tag attached to an automobile during production can be used to track its progress through the assembly line. Pharmaceuticals can be tracked through warehouses. Livestock and pets may have tags injected, allowing positive identification of the animal.

Since RFID tags can be attached to clothing, possessions, or even implanted within people, the possibility of reading personally-linked information without consent has raised privacy concerns.

1.2 WSN

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSN can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

In computer science and telecommunications, wireless sensor networks are an active research area with numerous workshops and conferences arranged each year.

1.3 M2M

Machine to machine (M2M) refers to technologies that allow both wireless and wired systems to communicate with other devices of the same ability. M2M uses a device (such as a sensor or meter) to capture an event (such as temperature, inventory level, etc.), which is relayed through a network (wireless, wired or hybrid) to an application (software program), that translates the captured event into meaningful information (for example, items need to be restocked). Such communication was originally accomplished by having a remote network of machines relay information back to a central hub for analysis, which would then be rerouted into a system like a personal computer.

However, modern M2M communication has expanded beyond a one-to-one connection and changed into a system of networks that transmits data to personal appliances. The expansion of IP networks across the world has made it far easier for M2M communication to take place and has lessened the amount of power and time necessary for information to be communicated between machines. These networks also allow an array of new business opportunities and connections between consumers and producers in terms of the products being sold.

2 .CLOUD COMPUTING IS THE BASIS FOR THE DEVELOPMENT OF THE INTERNET OF THINGS

Cloud computing is an ideal network application mode, which obtains the necessary services through the network according to the demand and the way of expansion. The terminal users do not need to understand the details and the corresponding professional knowledge. They do not control directly, only focusing the resources they need and obtaining the corresponding service through the network. Its purpose is to solve the large amounts of data storage and processing the Internet brought about. Massive data storage and computational issues will need more support of cloud computing technology. Therefore, we can say that the relationship of Internet and cloud computing is complementary: the progress of cloud computing technology is the powerful backing of a networked data processing, which

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will bring about the more rapid development of the networking industry.

3. THE CONCEPT OF BUSINESS INTELLIGENCE (BI)

Business Intelligence (BI) is an information technology dealing with the structure, functioning and management of organizations, by using the computational technique. The success of a company relies on information. BI is a systematic process of collecting, analyzing and information. That aims to achieve or conserve competitive advantages, preventing deviations in the company's activity, grabbing the opportunities on the market. Disseminating BI consists of a set of applications and technologies for data storing, accessing and analyzing, in order to help users make better decisions. So we can mention:

- providing business solutions at law costs, which can give advantages to the company;
- easy and fast data access for numerous and diverse users;
- providing the technological support for data analysis;
- building a collaborative environment;
- providing an open and scalable framework.

These solutions enable the intelligent usage and interpretation of business information. With their help, the users can better control the business practices and processes, analyzing the performance indicators. Decisions are more efficient if the information about the business environment and competitors are analyzed with such applications, which provide capabilities of extrapolation and making correct forecasts concerning the future economic trends and conditions. They offer companies and users on all the hierarchical levels a solid, complete and powerful technology for extracting, from a large volume of data, the key information, relevant and useful for decision process and business .

Business intelligence can significantly enhance enterprise efficiency, improve business performance. Recently, Business intelligence has been adopted by many industry enterprises, especially applied in the fields of telecommunications, finance and e-government. Besides, the fields of energy, logistics, tobacco and manufacturing are creative platforms of business intelligence.

4. INFLUENCE ON THE BUSINESS INTELLIGENCE FROM CLOUD COMPUTING AND IOT

Nowadays, BI has become an important target in the information construction among enterprises. Since many decision-makers and salesmen in enterprises hope to have a command of the market and the internal management of enterprises by introducing BI, there is an increasing demand for BI. In terms of the relationship between IOT and BI, on the one hand, the IOT needs to be achieved by a large processing system to analyze and manage intelligently, which is conducted by BI. As there is a large amount of data collected, it is necessary to use intelligent analyzing and processing system to realize its intellectualization. On the other hand, the establishment of IOT also provides a platform for the extended and fast development and application of BI. Traditionally, BI was just some kind of software. Clients could make analysis by connecting the BI with the server to compute. The old BI system operates on minicomputers with Unix system, which brings about limitation to the expansion of BI system. This kind of limitation is contradictory to the timeliness of information, making demands in business area difficult to fulfill. Some other problems about BI system are also caused by this limitation, such as poor expansion, inferior processing capacity, inability of processing mass data and relatively high cost etc.. In the age of IOT, the information acquisition system of IOT, such as RFID and other sensors, can provide a large amount of data source whose authenticity can also be guaranteed. These features can support some techniques like analysis of KPI, real-time inquiry, multidimensional analysis, prediction and data searching, accelerating the analyzing process enormously.

In view of the characteristics of BI and IOT, a conclusion can be reached: the combination of BI, IOT and Cloud Computing is a natural result. The combination of Cloud Computing and BI will break through the bottleneck of the current BI, thus meeting the companies' needs. Cloud Computing brings about some obvious characteristics for BI: First, under the circumstance of Cloud Computing, sharing of BI will be the greatest advantage. BI under Cloud Computing provides a platform for sharing information. The entity sharing service center can be achieved by powerful information

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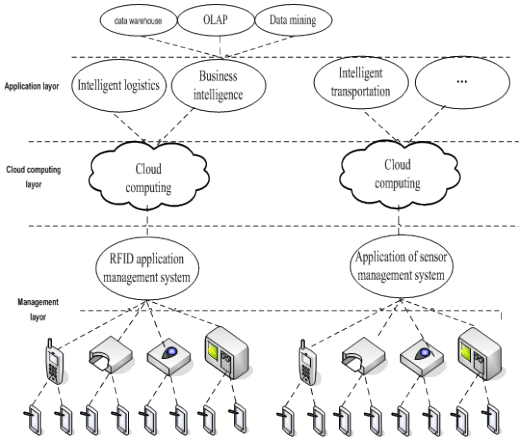
sharing, data sharing and computing sharing, etc. Because of the BI sharing under Cloud Computing, information and intelligence resources distributed in different areas can be integrated. And the companies' efficiency would be increased by means of scale economy, process re-engineering and management focusing. Second, Cloud Computing would raise the timeliness of BI. BI under Cloud Computing can load the business data distributed in different regions at any time, which can integrate historical data with personal data efficiently. In this way, the advanced functions of BI would be achieved, and the companies would benefit from it. Last but not least, the combination of Cloud Computing and BI enhances the openness of BI system. The traditional BI is comparatively closed, which obstructs the intelligence service. This problem will be solved under Cloud Computing circumstance, because the data will be more timely , and the data mining will be more open. Thus, the timeliness of data will be realized, which would meet the needs of the companies.

5 BUSINESS INTELLIGENCE STRUCTURE BASED ON IOT

As a new intelligent network, the basic architecture of IOT in future is shown in Figure 5.1,in which three layors are included: Management layor, Cloud computing layor, and Application layor with Business Intelligence as its an important part.



(1) Management layor

Management layor, including various electronic tags, readers and other RF terminal, various sensor s terminals and GPS terminal, is responsible for the acquisition of RFID, sensing, and location of information. This layer is responsible for the front end including tag identification, reading and writing, information management, access to public service platform ,and getting a variety of common application services of IOT.

(2) Cloud computing layor

A very large computing platform is formed by connecting a large number of low-cost computing units with IP network, whose core is to compose Cloud computing platform and management software. The former one, with the distinguished advantage of low cost, is to provide services for users by the virtual machine and image deployment.

(3)Application layor

Application layer makes information applied in various fields by providing common data interfaces. Intellectual services provided in business intelligence is based on the vast amounts of data collected through IOT. The core of the business intelligence system is a data warehouse system. To illustrate, the available data is formed with the analysis of large amounts of data, and then the pre-processed data is processed into information, which ,as the ultimate wisdom, will be used to guide business practices.

Business Intelligence has several components: an external data source, data warehouse modeling and construction tools, data management, access tools, decision supporting tools, business intelligence applications, and metadata management. They can provide data analysis and management through their collaboration within the system. The granularity and accuracy of the data can be greatly improved, based on a large number of real-time information provided by IOT. Therefore the data quality applied in business intelligence has also been well ensured.

6 OUTLOOK

Business intelligence architecture based on Internet of things will be the model of business intelligence network architecture in future, which not only can provide a basis for the development of the new software in business intelligence, and

data sources for data warehousing, online analytical processing, and data mining technology, but also can provide the more widely prospects to the application of business intelligence.

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7. FUTURE WORK

In the proposed system, we have more challenges like the global IoT application construction. Furthermore, the middle tier construction can be considered as a challenge due to different local applications and plans. Also, the security system is extremely important issue especially when we apply our proposed system in critical environment such as military or terrorism . Other issues like scalability, accuracy, and reliability should be considered.

The paper mainly describes the foundation of developing a using system of IoT technology. We are currently working on the designing phase of the implementation part. Our future goal is also to implement the system in a real scenario.

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