

Architecture Design of the Internet of Things based on Cloud Computing

Jiang Rui, Sun Danpeng
 Qujing Normal University; Yunnan Qujing 655011, China
 jiangrui2015_cn@126.com

Abstract—Importance and development advantage of the Internet of Things industry chain is discussed. The basic ideas and methods of the combination of cloud computing and the Internet of things are described. Combined with cloud computing, the unified Internet of Things operation management system framework is established. The framework of the new platform middleware layer uses the cloud computing technology, which greatly improves the operating efficiency of the Internet of things. Based on the framework, Internet of Things business operations platform construction scheme is proposed, it can be used as reference of the construction of the Internet of things platform design.

Keywords- Internet of Things; cloud computing; platform design

I. INTRODUCTION

With the fast development of computer technology, high-end technology has been applied to many fields in people's life[1,2]. The Internet of things technology aims to build a set of networks in which each object is connected. In the Internet of things, all mechanical equipment has the storage and computing power[3]. It improves the convenience greatly and meets the needs that people cannot imagine before[4,5]. Cloud computing technology combines parallel computing, distributed computing and grid computing. The developing of the Internet of things depends on high efficient storage and computing power, which is the advantage of cloud computing technology. That is why cloud computing technology is the basic of the internet of things[6]. The Internet of things technology which combines cloud computing technology collects and organizes data and information by using wireless sensor and radio frequency identification, then transmits it to the application layer of the cloud computing platform[7-9]. In this layer, the data can share and exchange, users can control and manage the whole system.

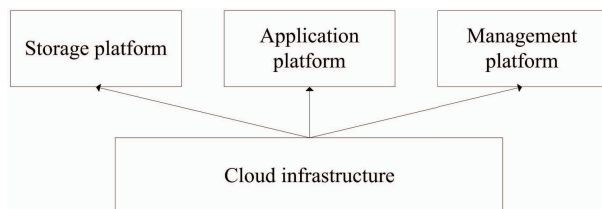


Figure 1. Basic platform of cloud computing combined with Internet of things

Internet of things involves a lot of technologies and standardization organizations, its industrial chain is huge and wide, its development needs the government's policy support, mutual cooperation and exchange between

enterprises, the joint efforts of the organization. We analyzes the development of the Internet of things in my country, telecom operators in its industry chain is shouldering the integrated industrial chain upstream and downstream and the facilitator role in the development of the Internet of things. Its perfect network resources and large customer is used to establish the basis of Internet information transmission bearing body and the industry calling is used for pushing the networking technology and business innovation. To play a role of the above, operators need to establish an open platform for the IOT operation management to realize intelligent pipe platform operation. On the one hand, it can expand their space for income, attracting a large number of developers to develop business in this platform. It also can provide aggregation of various kinds of applications, providing centralized services, further improving the operator's brand image.

Cloud computing has high speed Internet connection and the advantages of the almost unlimited storage and computing power compared with the traditional computing model[11-14]. Cloud computing integrates multiple computer entity to become a powerful computing system through the use of grid computing technology and the super computing power is assigned to the end user through the relevant technology. The biggest advantage of cloud computing is like super computer parallel processing for the application and the cost is very low.

II. FUSION OF CLOUD COMPUTING AND INTERNET OF THINGS IN STAGES

The combination of the Internet of things and cloud computing will inevitably lead to the development of economic. If the combination of the Internet of things and cloud computing is periodically described, it can be roughly divided into the following three stages. In the first stage, information and data is taken as factors to be used, which improves the efficiency of the enterprises. The second phase changed the traditional way of production and management, optimizing the structure of system gradually. The third stage prompts the information fusion and optimizes the structure of industry as a whole. Basic platform of cloud computing combined with Internet of things is shown in figure 1.

After cloud computing combined with Internet of things technology, it can get more contact data and information. The enormous computing power and storage capacity of cloud computing can well reflect the state of the production process and timely meet various needs. Moreover, information and data can be centralized managed. A detailed analysis of data to get the conclusion and summarizes and

continuously adjusting and optimizing the whole system makes the production high efficiency and low cost.

In the second stage, the focus is to optimize the mode of production based on the management and use of information. Intelligent Internet of things technology implements the automatic monitoring and remote scheduling on the part of the production process, making the production reach the automation and centralized. And through the cloud computing intelligent information platform, it significantly reduces the human error, and reaches precise control and the management pattern.

The final phase is complete fusion stage and this stage information fusion promotes the whole reconstruction and upgrading of enterprises. And the Internet of things achieves the continuous innovation in service model and cloud computing technology builds a collaborative platform auxiliary production mode. New stage of information fusion is a kind of cross-industry information fusion, which constantly creates new technology and new value.

III. PATTERN CLASSIFICATION

Cloud computing and Internet of things has many advantages. If they are combined, it can play a good role. Do a simple example, in the Internet of things combined with cloud computing, cloud computing is the control center of the Internet of things cloud, it is equivalent to the brain of the center and the Internet of things realizes application effect through the control of cloud. Internet of things is similar to the limbs and facial features. Such coordination work makes the Internet cloud play a proper role. Internet of things technology combined with cloud computing can be divided into the following pattern.

One is single center and multiple terminal mode. Distribution range of this mode is small and Internet of things terminal takes the cloud center as a data processing center. Terminal information and data is dealt with and stored by the cloud center. The cloud center provides a unified interface for the user operation and view. This kind of cloud center can provide mass storage, unified interface and hierarchical management and other functions, which facilitates the human daily life. This model is mainly used in the monitoring of the community and family, some aspects such as public infrastructure.

The second is mode of multiple centers and multiple terminals. This mode is mainly suitable for enterprises and units of large areas span. The application premise of this mode is that cloud center must include two cloud forms of public and private cloud and the network interconnection between them has no obstacle. For the high security requirements of information and data, it can better meet the safety requirements without affecting the other data and information transmission.

Hierarchical processing of information and application is mass terminal. For a large amount of data transmission, but the security requirement is not high, such as video data, games, etc., we can take the local center to deal with storage. For computing demand is high, the amount of data is not large, it can be stored in a special cloud center responsible

for high-speed operation. For data and information needing very high security demand, it can be stored in the cloud center with security center.

IV. OPERATION MANAGEMENT PLATFORM

Combined with cloud computing, we put forward the unified IOT operation management system framework and the framework of the new platform middleware layer uses the cloud computing technology. It greatly improves the operating efficiency of the Internet of things. And based on the framework, we proposed IOT business operations platform construction scheme of the system structure, it can be used as reference of the construction of the Internet of things platform design.

In this paper, combined with cloud computing technology, by means of induction and analysis, a unified IOT operation management system architecture based on cloud computing is proposed, including perception, access bearing layer, platform middleware layer and application layer.

(1) Aware layer can be divided into two sub layers, which are information collection and communication subnet. Information acquisition layer involves the sensor technology and recognition technology, including M2M, bar code, RFID, sensors and cameras. Subnet mostly uses the short distance communication technology to form peripheral network, such as Zigbee, WiFi, UWB, bluetooth, the extension of broadband network and some integrated communication module, etc.

(2) Access bearing layer is divided into two sub-layer of access network and core network. Access bearing layer can be roughly divided into cable access and wireless access. Wireless access is cellular, WiFi, microwave and satellite, etc. The cable access can be the Internet and PSTN. Core sublayer is corresponding to the transmission network and core network in view of the operator, such as mainstream transmission technologies of PTN, OTN and SDH, 2G, 3G, LTE and the NGN network.

(3) Platform middleware layer includes data gathering and intelligent processing two sub layers, which is the core level of Internet of Things operation management system and is the core layer of the terminal management and business management. The layer includes Internet cloud platform management center, data center, infrastructure and control center. It has the essential characteristics of the mass data processing calculation and high reliability, which embodies the advantages of cloud computing services. So, constructing the platform middleware layer of Internet of things based on cloud computing can deal with the huge amounts of data generated by the Internet of things application, which is a very good solution. Below the layer is introduced in details.

(4) Application layer include application support and APP layer. The function of application support layer is that developers carry out authentication and certification logos parsing and equipment management for the end user. If the application development and business operation comes from the same company, the function of this layer can be put in the business operation platform.

Middleware layer based on cloud computing includes the hardware architecture of cloud, cloud software architecture, cloud management architecture and cloud application architecture. The layer structure and function is as follow.

The core of hardware architecture is the construction of infrastructure, through the use of virtualization technology, the network, storage, servers, and input and output resources is formed as the virtual cluster, which is used for the upper cloud software architecture. Using virtualization technology will manage physical units of different core technologies from different vendors. Then it provides services to the world. Through the distributed parallel environment, it can monitor system performance, configuration and alarm data, and realize automatic detection and maintenance of physical units, forming a flexible virtual cluster. This kind of system architecture, running simultaneously on multiple physical units, can be very convenient to replace or add new physical unit as a service node, it has very strong capacity of parallel computing and fault tolerance ability, which can guarantee the fast response and high reliability of the service.

Cloud software architecture is made up of three parts of data, services and access center. Data center is the core of the whole architecture, according to the different types, they are divided into four categories of real-time database, database, knowledge base and model base. The centre store all the data of the company and data of a third party. The data center needs to solve three key problems of the distributed file system, distributed database and distributed model. For service center, the data and information is in the form of service encapsulation according to the needs of the application, which provides software, platform, storage and computing services and other services. Now more mature service center adopts SOA (service oriented architecture) architecture, which is a coarse-grained, loosely coupled service architecture. There is a simple, accurate definition of communication interface between the service and it does not involve the underlying programming interface and the communication model. Its advantages is to help enterprise to set up system architecture fast and more reliably. Access center role is to control the access of users to ensure the security of the system, which provides the application adapter, access control, access management, display and third party applications embedded management.

Cloud application has realized the business process of industry application, which can be used as a part of the cloud platform, and can also integrate third-party industry applications, such as traffic logistics, health monitoring and agriculture monitoring. It is needed that multi-user share resource and information is isolated to ensure data security at the same time through the application of hierarchical management. Cloud management can provide on-demand pricing function, according to the usage volume and it also needs to implement security management and information management of cloud users.

V. CONCLUSIONS

Internet of things is the network based on global electronic product code, RFID technology, the next

generation of network, mobile network, the Internet and wireless communication technologies, which is developed of the object to object network. The Internet of things will go deep into all aspects of physical world, further strengthen the social informatization, it greatly influences and improves people's life style, improves the work efficiency. Therefore, the emergence of the Internet of things has caused the global communications industry and governments attention, showing a booming trend. As an emerging industry, the Internet of things huge development potential and attractive prospects for development will promote the prosperity of the global information industry development, bring new sources of growth in all walks of life. The technology of Internet of things and cloud computing is introduced, from the concept and definition, characteristics, system architecture and key technology in detail, focusing on Internet of things' industry chain and business models related to operators, and some reasonable suggestions are given. Combined with cloud computing, the unified Internet of Things operation management system framework is put forward.

REFERENCES

- [1] Miguel Castro, Antonio J. Jara, Antonio F. Skarmeta. An analysis of M2M platforms: challenges and opportunities for the Internet of Things. 2012 Sixth International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing, 2012:757-762.
- [2] G C. Fox, Supun Kamburugamuve, Architecture and Measured Characteristics of a Cloud Based Internet of Things API. 2012 international conference on Collaboration Technologies and Systems (CTS), 2012:6-12.
- [3] Daojing He, Chun Chen, Chan, S., Jiajun Bu, Vasilakos, A.V. A Distributed Trust Evaluation Model and Its Application Scenarios for Medical Sensor Networks. Information Technology in Biomedicine, IEEE Transactions on, 2012(16): 1164-1175.
- [4] Kai-Di Chang, Jiann-Liang Chen, Chi-Yuan Chen, Han-Chieh Chao. IoT operations management and traffic analysis for Future Internet. Communications and Applications Conference, 2012: 138-142.
- [5] Welbourne E, Battle L, Cole G, Gould K, Rector K, Raymer S, et al. Building the internet of things using RFID: the RFID ecosystem experience. IEEE Internet Computing 2009, 13(3):48-55.
- [6] Marozzo F, Talia D, Trunzio P. P2P-MapReduce: Parallel data processing in dynamic Cloud environments. Journal of Computer and System Sciences, 2012, 78(5): 1382-1402.
- [7] Zhu H B, Yang L X, Yu Q. Investigation of technical thought and application strategy for the internet of things. Journal of China Institute of Communications, 2010, 31(11): 2-9.
- [8] De Leusse P, Periorelli P, Dimitrakos T, et al. Self Managed Security Cell, a security model for the Internet of Things and Services. Advances in Future Internet, 2009 First International Conference on. IEEE, 2009:47-52.
- [9] Hamad F, Smalov L, James A. Energy-aware Security in M-Commerce and the Internet of Things, IETE Technical review, 2009, 26(5): 357-362.
- [10] Atzori L, Iera A, Morabito G. From smart objects to social objects: The next evolutionary step of the internet of things. Communications Magazine, IEEE, 2014, 52(1): 97-105.
- [11] Chih-Hua Chang, Hung-Yun Hsieh. Not every bit counts: A resource allocation problem for data gathering in machine-to-machine communications. Global Communications Conference (GLOBECOM), 2012:5537-5543.

- [12] Zorzi M, Gluhak A, Lange S, Bassi A. From today's INTRANet of things to a future INTERNet of things: a wireless- and mobility-related view. *IEEE Wireless Communications* 2010,17(6):44-51.
- [13] Leusse P, Periorellis P, et al. Self managed security cell, a security model for the Internet of Things and Services. *Proceedings of the 2009 First International Conference on Advances in Future Internet*. Piscataway: IEEE, pp:47-52.
- [14] M. Yuriyama and T. Kushida, Sensor-Cloud Infrastructure Physical Sensor Management with Virtualized Sensors on Cloud Computing, Sept. 2010, pp. 1-8.