Research on the Technology of IOT Based on Cloud Computing

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Abstract: In this paper, research contents are shown as follows: by studying the new technology of Internet of things based on cloud computing. The basic ideas and methods of the combination of cloud computing and the Internet of things are described. by combining cloud computing and The Internet of things, Design of the function modules of intelligent water resources management system. To describe the combination of cloud computing and the Internet of things is rea-sonableness; summarizes the what problems do the development of this technology have, and put forward own ideas to solve security problems. To ensure the efficiency, introducing clustering algorithms in transport layer it is can reduce the loss of the data. Classify the data by different security levels in application layer and make the different degrees of protec-tion with different data. Considering three layer model of the database structures, design a ploy of permissions allocation. In this ploy, every allocation of permission need a complete authentication, it can avoid the security issues caused by unauthorized users gaining unauthorized privileges in traditional system. Besides, the support of the secondary development is the necessary demand in the development of Internet of things technology, classify the things in the Internet of things can make the user design it to meet demand by themselves.

Keywords: IOT, cloud computing, cloud platform, network security protection.

1. INTRODUCTION

With the fast development of computer technology, high-end technology has been applied to many fields in people's life, being familiar with computer intelligent. It's convenient with life and work of 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. It improves the convenience greatly and meets the needs that people cannot imagine before. 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 [1]. 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 to the application layer of the cloud computing platform, in this layer, the data can share and exchange, users can control and manage the whole system [2].

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 et. technology, 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 lifestyle, improves the work efficiency. Therefore, the emergence of the Internet of things has caused the global communications industry and governments attention, showing a booming potential trend. As an emerging industry, the Internet of things huge development 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.

2. BASIC TECHNOLOGY

2.1. Ubiquitous Computing in the Next Decade

The effort by researchers to create a human-to-human interface through technology in the late 1980s resulted in the creation of the ubiquitous computing discipline, whose objective is to embed technology into the background of everyday life [3]. Currently, we are in the post-PC era where smart phones and other handheld devices are changing our environment by making it more interactive as well as informative. Mark Weiser, the forefather of Ubiquitous Computing (ubicomp), defined a smart environment [4] as “the physical world that is richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives, and connected through a continuous network”.

The creation of the Internet has marked a foremost milestone towards achieving vision which enables individual devices to communicate with any other device in the world. The inter-networking reveals the potential of a seemingly
endless amount of distributed computing resources and storage owned by various owners (Fig. 1).

![Cloud computing type](image)

**Fig. (1).** Cloud computing type.

### 2.2. Definitions

According to Cluster of European research projects on the Internet of Things [5]—‘Things’ are active participants in business, information and social processes where they are enabled to interact and communicate among themselves and with the environment by exchanging data and information sensed about the environment, while reacting autonomously to the real/physical world events and influencing it by running processes that trigger actions and create services with or without direct human intervention.

As human gathering centers and trade centers, cities are the signs of human civilization progress. Urbanization is an inevitable trend of urban development. The way towards urbanization is coupled with a string of social problems, which is exemplified by the low efficiency of urban management model, crowded traffic system, emergency system without actual effect, and 119 incomplete environmental monitoring system, etc. Digital cities collect, analyze and deal with urban management problems based on various technical means such as GPS, GIS, RS, computers, network communication and so on. Significant results are obtained by implement of grid management and urban component management in urban order, traffic, sanitation and planning. Smart cities’ information systems must have enhanced computing power, sensory ability and data application. The development of cloud computing, Internet of things and semantic net is the matter of feasibility to the construction of smart cities. The research of cloud computing, Internet of Things and the Semantic Web application infrastructure and key technology has important theoretical significance and practical value (Fig. 2).

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. Analyzing 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, using its perfect network resources and large customer to establish the basis of Internet information transmission bearing body, uses the industry called 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, [6] intelligent pipe platform operation. On the one hand, we are expanding their space for income, attracting a large number of developers to develop business in this platform, aggregation of various kinds of applications, providing centralized services, further improving the operator's brand image. Based on the above reasons, this article’s research has important theoretical value and practical significance (Fig. 3).

Currently the information systems used in most companies are built by themselves, and can only be used for the internal. Information between each company can not be shared effectively. The upfront and maintenance cost is also very high. To solve this problem, this thesis purposes one design method of the information management system based on cloud computing. This method takes full advantages of cloud computing, reaches the goals that share the equipments, information and services, and can help enterprises reducing cost and sharing resources [7].

### 3. IOT ELEMENTS

We present a taxonomy that will aid in defining the components required for the Internet of Things from a high level perspective. Specific taxonomies of each component can be found elsewhere. There are three IOT components which enables seamless: (a) Hardware-made up of sensors, actuators and embedded communication hardware (b) Middleware-on demand storage and computing tools for data analytics and (c) Presentation-novel easy to understand visualization and interpretation tools which can be widely accessed on different platforms and which can be designed for different applications. In this section, we discuss a few enabling technologies in these categories which will make up the three components stated above as shown in (Table 1).

### 3.1. Wireless Sensor Networks (WSN)

Recent technological advances in low power integrated circuits and wireless communications have made available efficient, low cost, low power miniature devices for use in remote sensing applications. The combination of these factors has improved the viability of utilizing a sensor network consisting of a large number of intelligent sensors, enabling the collection, processing, analysis and dissemination of valuable information, gathered in a variety of environments. Active RFID is nearly the same as the lower end WSN nodes with limited processing capability and storage. The scientific challenges that must be overcome in order to realize the enormous potential of WSNs are substantial and multidisciplinary in nature. Sensor data are shared among sensor nodes and sent to a distributed or centralized system for analytics (Fig. 4).

### 3.2. Data Storage and Analytics

One of the most important outcomes of this emerging field is the creation of an unprecedented amount of data. Storage, ownership and expiry of the data become critical issues. The internet consumes up to 5% of the total energy generated today and with these types of demands, it is sure to go up even further. Hence, data centers that run on harvested energy and are centralized will ensure energy efficiency as well as reliability. The data have to be stored and used intelligently for smart monitoring and actuation. It is important to develop artificial intelligence algorithms which could be centralized or distributed based on the need. Novel fusion algorithms need to be developed to make sense of the data.
Fig. (2). Internet of things schematic showing the end users and application areas based on data.

Fig. (3). Gartner 2012 hype cycle of emerging technologies Gartner Inc.
Table 1. Smart environment application domains.

<table>
<thead>
<tr>
<th>Smart Home/office</th>
<th>Smart Retail</th>
<th>Smart City</th>
<th>Smart Agriculture/forest</th>
<th>Smart Water</th>
<th>Smart Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network size</td>
<td>Small</td>
<td>Small</td>
<td>Medium</td>
<td>Medium/large</td>
<td>Large</td>
</tr>
<tr>
<td>Users</td>
<td>Very few, family members</td>
<td>Few, community level</td>
<td>Many, policy makers, general public</td>
<td>Few, landowners, policy makers</td>
<td>Few, government, Large, general public</td>
</tr>
<tr>
<td>Energy</td>
<td>Rechargeable battery</td>
<td>Rechargeable battery</td>
<td>Rechargeable battery, energy harvesting</td>
<td>Energy harvesting</td>
<td>Energy harvesting, Rechargeable battery, Energy harvesting</td>
</tr>
<tr>
<td>Internet connectivity</td>
<td>Wifi, 3G, 4G LTE backbone</td>
<td>Wifi, 3G, 4G LTE backbone</td>
<td>Wifi, 3G, 4G LTE backbone</td>
<td>Wifi, satellite communication</td>
<td>Satelite communication, microwave links, Wifi, satellite communication</td>
</tr>
<tr>
<td>Data management</td>
<td>Local server</td>
<td>Local server</td>
<td>Shared server</td>
<td>Local server, shared server</td>
<td>Shared server, Shared server</td>
</tr>
<tr>
<td>IoT devices</td>
<td>RFID, WSN</td>
<td>RFID, WSN</td>
<td>RFID, WSN</td>
<td>WSN</td>
<td>Single sensors, RFID, WSN, single sensors</td>
</tr>
<tr>
<td>Bandwidth require</td>
<td>Small</td>
<td>Small</td>
<td>Large</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Fig. (4). Conceptual IOT framework with cloud computing at the center.
the electricity (utility) company which can in turn optimize electricity usage data in the house and makes it available to crossover in applications and the use of data between domains. There is a huge opportunity, Utility IoT, individual or home, Enterprise and its application domains: (1) Personal and Home; (2) Enterprise; (3) Utilities; and (4) Mobile. This is depicted in (Fig. 1), which represents Personal and Home IOT at the scale of an individual or home, Enterprise IOT at the scale of a community, Utility IOT at a national or regional scale and Mobile IOT which is usually spread across other domains mainly due to the nature of connectivity and scale. There is a huge crossover in applications and the use of data between domains. For instance, the Personal and Home IoT produces electricity usage data in the house and makes it available to the electricity (utility) company which can in turn optimize the supply and demand in the Utility IOT. The internet enables sharing of data between different service providers in a seamless manner creating multiple business opportunities. A few typical applications in each domain are given.

The Aneka scheduler is responsible for assigning each resource to a task in an application for execution based on user QoS parameters and the overall cost for the service provider. Depending on the computation and data requirements of each Sensor Application, it directs the dynamic resource provisioning component to instantiate or terminates a specified number of computing, storage, and network resources while maintaining a queue of tasks to be scheduled. This logic is embedded as multi-objective application scheduling algorithms. The scheduler is able to manage resource failures by reallocating those tasks to other suitable Cloud resources.

The Dynamic Resource Provisioning component implements the logic for provisioning and managing virtualized resources in the private and public cloud computing environments based on the resource requirements as directed by the application scheduler. This is achieved by dynamically negotiating with the Cloud Infrastructure as a Service (IaaS) providers for the right kind of resource for a certain time and cost by taking into account the past execution history of applications and budget availability. This decision is made at runtime, when SaaS applications continuously send requests to the Aneka cloud platform.

As discussed earlier, to realize the vision, tools and data need to be shared between application developers to create new apps. There are two major hurdles in such an implementation. Firstly, interaction between clouds becomes critical which is addressed by Aneka in the InterCloud model. Aneka support for the InterCloud model enables the creation of a hybrid Cloud computing environment that combines the resources of private and public Clouds. That is, whenever a private Cloud is unable to meet application QoS requirements, Aneka leases extra capability from a public Cloud to ensure that the application is able to execute within a specified deadline in a seamless manner. Secondly, data analytics and artificial intelligence tools are computationally demanding, which requires huge resources. For data analytics and artificial intelligence tools, the Aneka task programming model provides the ability of expressing applications as a collection of independent tasks. Each task can perform different operations, or the same operation on different data, and can be executed in any order by the runtime environment. In order to demonstrate this, we have used a scenario where there are multiple analytics algorithms and multiple data sources. A schematic of the interaction between Aneka and Azure is given in (Fig. 7), where Aneka Worker Containers are deployed as instances of Azure Worker Role. The Aneka Master Container will be deployed in the on-premises private cloud, while Aneka Worker Containers will be run as instances of Microsoft Azure Worker Role. As shown in (Fig. 8), there are two types of Microsoft Azure Worker Roles used. These are the Aneka Worker Role and Message Proxy Role. In this case, one instance of the Message Proxy Role and at least one instance of the Aneka Worker Role are deployed. The maximum number of instances of the Aneka Worker Role that can be launched is limited by the subscription offer of Microsoft Azure Service that a user selects. In
Fig. (5). Elastic archiving based on EUCALYPTUS cloud.

Fig. (6). A model of end-to-end interaction between various stakeholders in cloud centric IOT framework.

this deployment scenario, when a user submits an application to the Aneka Master, the job units will be scheduled by the Aneka Master by leveraging on-premises Aneka Workers, if they exist, and Aneka Worker instances on Microsoft Azure simultaneously. When Aneka Workers finish the execution of Aneka work units, they will send the results back to Aneka Master, and then Aneka Master will send the result back to the user application.

Some open challenges are discussed based on the IOT elements presented earlier. The challenges include IOT specific challenges such as privacy, participatory sensing, data analytics, GIS based visualization and Cloud computing apart from the standard WSN challenges including architecture, energy efficiency, security, protocols, and Quality of Service. The end goal is to have Plug n’ Play smart objects which can be deployed in any environment with an interoperable backbone allowing them to blend with other smart objects around them. Standardization of frequency bands and protocols plays a pivotal role in accomplishing this goal. A roadmap of key developments in IOT research in the context of pervasive applications, which includes the technology drivers and key application outcomes expected in the next decade.

CONCLUSION

Ubiquitous sensing enabled by Wireless Sensor Network (WSN) technologies cuts across many areas of modern day
living. This offers the ability to measure, infer and understand environmental indicators, from delicate ecologies and natural resources to urban environments. The proliferation of these devices in a communicating–actuating network creates the Internet of Things (IOT), wherein sensors and actuators blend seamlessly with the environment around us, and the information is shared across platforms in order to develop a common operating picture (COP). Fueled by the recent adaptation of a variety of enabling wireless technologies such as RFID tags and embedded sensor and actuator nodes, the IOT has stepped out of its infancy and is the next revolutionary technology in transforming the Internet into a fully integrated Future Internet. As we move from www (static pages web) to web2 (social networking web) to web3 (ubiquitous computing
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web), the need for data-on-demand using sophisticated intuitive queries increases significantly. This paper presents a Cloud centric vision for worldwide implementation of Internet of Things. The key enabling technologies and application domains that are likely to drive IOT research in the near future are discussed. A Cloud implementation using Aneka, which is based on interaction of private and public Clouds, is presented. We conclude our IOT vision by expanding on the need for convergence of WSN, the Internet and distributed computing directed at technological research community.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

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