

The application and Implementation research of Smart City in China

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Abstract—Beginning with the explanation of smart city, this paper firstly gave the definition of smart city based on the existing researches and discussed the four characteristics of smart city, which were about interconnection, integration, cooperation and application for the urban information systems. Secondly the development processes of smart city were discussed, and it showed that smart city was the consequence of information technology evolution. Thirdly, the construction modes of smart city in China were summarized, which included constructing integrating smart city, developing smart industry, smart management and service, smart technology and infrastructure, and smart humanity and living. Fourthly construction modes of smart city in China were analyzed from the point of construction routes and countermeasures. Finally, the six trends of smart city were given for government decision-makers and relevant researchers.

Keywords—Smart city; Information Technology; Things of internet; Internet

I. INTRODUCTION

With the development and application of the internet of things, mobile broadband network, next generation, cloud computing and etc, informatization has a tendency of higher smarter stage [1].

IBM Corporation in November 2008 issued the concept of "Smart Earth". The principle of Smart Earth is that, sensors are embedded in the railways, bridges, tunnels, roads, buildings, water systems, dams, commercial equipment and medical equipment, and then physical facilities can be perceived, so information technology extends into physical world[2], constructing a "Internet of Things".

Furthermore, Internet of Things can be connected with internet to integer the human society and physical system. People, machine, equipment, and etc can be managed in the integrated system through computer and cloud computing, so the people's production and life can be managed more precisely and dynamically to get smarter, raise resource usage and productivity and improve the relationship between people and nature.

Some experts have researched smarter city. Jia-Yao Wang thinks that "Smart City" is to make the city smarter, also to make the people smarter in the city. Through internet, "Smart City" connects the sensors to sense the city, and process the sensing information by cloud computing and so on to integrate cyber space and things of internet, and make

intelligent response to the calling of e-government, our people, environment, public safety and etc [3].

Stamatis Karnouskos thinks that smart city starts with a number of households, vehicles and power stations. A city can run as a standalone or connected to others. Its area is placed at the origin of a coordinated system or as a neighbor to an existing reference city e.g. on north, south, east or west.[4]

Mahmoud Al-Hader thinks that a smart city provides interoperable, Internet-based government services that enable ubiquitous connectivity to transform key government processes, both internally across departments and employees and externally to citizens and businesses. Smart city services are accessible through wireless mobile devices and are enabled by services oriented enterprise architecture including Web services, the Extensible Markup Language (XML), and mobilized software applications.[5]

From above study, we think that through utilizing next generation of ICT (Information and communication technology), such as things of internet, cloud computing, smart city integrate urban information system, and fulfill high intelligent urban management, operation and people's life. In order to this target, smart city must utilize information, knowledge, experience and other resources and intelligent technologies, integrate and collaborate with urban information systems, construct next new generation of ICT infrastructure, achieve the goals of high efficiency of city management, timely and convenient service, reliable urban operation, green economy and comfortable living. So smart city utilizes next new generation ICT, such as things of internet, cloud computing, and is the higher stage of city information after digital city and intelligent city.

II. CHARACTERISTICS OF SMART CITY

Smart city includes smart infrastructure, smart operation, smart service and smart industry, and has four basic characteristics:

1. Interconnection between urban parts. Smart city will integer communication network, internet, sensor and recognition to extend the communication between people to the communication, sense and recognition between people and things, things and things, and thus interconnection between urban parts will be realized.

2. Integration of urban information systems. Things of internet and cloud computing will be used in every business

field and integrate application systems, data and internet to be the core elements supporting urban operation and management.

3. Urban management and service cooperation. Interconnection of urban components and highly integrated application system support urban management and service with the coordination of urban critical system and participants to make urban run best.

4. Application of new next ICT. Smart city makes modern city management theory as guide, emphasizes the application of advanced information technology into urban management and service, and inspires government, enterprise and people to make innovation, the urban development motion.

III. DEVELOPMENT PROCESSES OF SMART CITY

A. *Smart city is the high stage of urban information*

Digital city started from the "Information Highway" put forward by Clinton government in 1993. Digital City utilizes GIS (Geographic Information System), GPS (Global Positioning System), RS (Remote Sensing) to organize related social and economic data scientifically and form three dimensional digital reviews with the functions, such as information query, monitoring, decision support and so on[6].

Intelligent city evolves from IT2000 issued by Singapore Government. Intelligent city utilizes intelligent information network to share information, resource and tasks based on modern information technology, such as artificial intelligence, intelligent control software, expert decision system and sensor to make urban run intelligently. The emphasis of intelligent city is information system comprehensive integration of urban inner businesses.

Smart city was put forward by IBM in 2008[7]. The core idea of smart city is to integrate and collaborate with urban information systems by utilizing new next ICT, such as things of internet, cloud computing and so on.

B. *Smart city is the result of new next ICT innovation application*

After entering into 21 century, new next ICT develops quickly, which establish the technical base for smart city.

Firstly, things of internet, the important base of smart city, solved the problems, such as data collection, access and transmit. Things of internet is a things recognizing, positioning, tracing and management network by exchanging and transmitting information between things according the agreed protocol through RFID, infrared sensor, GPS, laser scanning and so on.

Secondly, cloud computing has high efficiency of information processing, which develops a new commercial mode for information quick diffusion.

Cloud computing is a distributed computing mode, which provides new IT service for users, such as information infrastructure, platform, software and so on.

With the development of cloud computing commercial mode, cloud computing will be used cheaply by users like the

public products, such as electricity, water and gas, which will change the structure of ICT, people's living, production of enterprise, and management of government.

Thirdly, the development of mobile communication technology, such as the fourth mobile technology and signal processing, provides technical basement for the application of broadband in the smart city, which expands geospatial space for the construction of smart city and solves the high speed transmission of information.

Finally, system integration provides the possibility for smart city by integrating software, hardware, operating system, database, and network and business application systems.

C. *Smart city is the comprehensive integration of data and information*

The comprehensive integration of data and information can be understood from the following three points: the integration of data, the integration of business information, the integration of urban information.

Firstly, the integration is the base of smart city. For example, corporation database, geographic database, demographic database and macroeconomic database should be integrated, which is the premise of information systems integration.

Secondly, all business information should be integrated. With the application development of e-government, information systems have been basically built by each unit for every business system. But, single business information system cannot meet the needs of urban development; information cross business and unit should be integrated.

Finally, smart city requests the connection, sharing and integration of all the urban system. With the expansion of urban and people, resource is consumed seriously, traffic pressure and environment pollution are tense. All urban parts are connected and the city should be considered as one system.

IV. CONSTRUCTION MODES ANALYSIS OF SMART CITY IN CHINA

Smart city is becoming the orientation of domestic urban development. The abroad countries mainly focus on the infrastructure, industry, application and service. For example, the United States, Britain, Japan and Korea put emphasis on the next generation of optical fiber, wireless mobile access, the next generation of internet, and speed up the smart city systems, such as smart grid, smart transportation, smart environment protection, smart ecology and smart city operation, and take the smart grid, smart transportation, smart ecology and environment protection as the main content of smart service, and take the smart manufacturing, information industry, modern logistics, e-commerce and digital content and so on as the core of smart industries.

In China, BeiJing, ShangHai, GuangZhou, ChongQing and other cities have launched "smart city" strategy, which is to strength city management, improve city service and ameliorate city function. Some cities focus on the integration of smart city, such as smart ShenZhen and smart NanJing. Some cites put

emphasis on the important points according to the city development, such as digital NanChang, Healthy ChongQing and Ecological ShenYang. There are four modes of smart city, which is integrating mode, technology oriented mode, process oriented mode and result oriented mode. All the modes are to make living convenient, promote government efficiency and stimulate economy for enhance international competitiveness and sustainable development based on ICT by providing real time, interactive and integrating service.

A. Constructing integrating smart city

This mode takes the construction of smart city as the most important way of promoting city innovation and competitiveness. For example, ShenZhen launched “smart ShenZhen” strategy, which is to improve smart infrastructure, developing support system of e-commerce, promoting smart transportation, cultivating smart industry base, as the breakpoint of constructing National Innovation City.

NanJing proposed “smart NanJing” strategy, which includes smart infrastructure, smart industry, smart government and smart Humanity. The strategy is regarded as the carrier of business, supporting of innovation, power of development, and promote industry restructuring and upgrading, speeding up the economy, fundamentally improving the comprehensive competitiveness of the overall NanJing.

B. Developing Smart Industry

WuHan cooperates with IBM to promote things of internet, out sourcing, cloud computing and so on smart industries, boost information construction, integration of city circle by utilizing software, platform and experience of IBM.

KunShan produced 1/2 notebook computer and 1/8 digital camera for the world. So KunShan proposed developing things of internet, digital information, and smart equipment and so on smart industry.

C. Smart management and service

KunMing cooperates with IBM to construct smart transportation, smart medical care, and smart e-government to improve city operation and management.

ShenYang is a heavy industry and dedicated to the transition from the heavy industrial city to the sustainable development of eco-city. So ShenYang cooperates with IBM to build “eco-Shenyang”

D. Smart technology and infrastructure

HangZhou proposes “green smart city” to develop information, environment protection, new material and so on smart industry. NanChang proposes “digital NanChang”, which improve public information service by implementing smart transportation, emergency system, digital city management and so on.

E. Smart humanity and living

Chengdu proposes “smart humanity” to construct smart city, which includes raising the quality of urban residents, improve the talents’ mechanism of cultivation, introduction and usage.

Chongqing proposed “smart city”, including ecological environment, medical care, social security and so on to improve citizens’ health and living quality.

V. CONSTRUCTION MODES OF SMART CITY IN CHINA

A. Construction routes of smart city

Since the 1990s, the pace of urbanization has accelerated significantly, and a lot of domestic cities strengthen urban management by utilizing information technologies. From IBM proposed “smart city” in 2009, some cities promotes the construction of smart city actively by introducing abroad information technology and advanced concepts to explore urban information construction mode.

- Constructing information systems of important fields

Under the background of new next generation of ICT and accelerating knowledge economy, domestic cities put emphasis on the intelligent building, intelligent housing, smart hospital, roads monitoring, food and drug administration, ticket management, home care, digital living and many fields to accelerate economy transformation, improve resource efficiency and living based on internet, things of internet, telecommunication network, broad wireless net and so on.

- Constructing overall smart city system

Long target of constructing smart city for domestic cities is to promote the things of internet, cloud computing and other information technologies applied in the fields, such as independent innovation, industry development, public service, society management, resource allocation and other respects. It includes backup and sharing of public data; automating and intelligent management of city operation; intelligent identifying of public security system; society management system of covering overall process; balanced development of public service; strategic emerging industries, such as e-commerce and digital things; highly collaborative e-government system.

B. Countermeasures of constructing smart city

Some cities in China began to construct “Smart city” since it was proposed by IBM.

- Grasping advanced concepts to construct city

Smart city was proposed by IBM, which is to sense, analyze and use all key information of city management system to make intelligent response. Smart city in China should integrate existing resources to connect all systems. The target of smart city is not only the intelligence of information technology, but also the sustainable development and living necessities.

- Exploring front technologies

Some Chinese cities not only explore high technologies, such as things of internet, cloud computing, virtual computing and other technologies, but also pay attention to the optimization and upgrading of traditional information technology and the convergence of traditional information technology and front technologies

- Government is a major driving force of promoting information

Government should support the overall plan, implementation, and decision-making management of information and plan the target, frame, task and so on of all field information.

- Deploying information infrastructure in advance

Information infrastructure is the base of smart city, and next information network will follow the principles, such as Broadband, convergence, ubiquitous, safety. Some domestic cities speed up the construction of broadband networks.

- Promoting public service information system

In the construction of smart city, each city pays attention to the public field construction, strengthening the overall planning, promoting e-government and information development in public domains to improve the collaboration.

VI. TRENDS OF SMART CITY

Smart city is the evolution of digital city with new generation of information technology. It can change interaction mode through new next information technology, improve the real-time information processing capability, enhancing business flexibility and continuity and promote the sustainable development of the city. Now, some domestic and foreign cities worked out "smart city" strategy. Smart city can reflect the following situations.

A. *Information infrastructure: high speed, broadband, convergence and wireless net*

Up to now, information net infrastructure is in the period of changing, for example, the integration of telecommunications networks, cable TV networks and the Internet, rapid progress of new next internet, convergence of internet and things of internet, cloud computing, make the intelligent information infrastructure with broad band, convergence and wireless come true to meet the needs that anyone can access internet anywhere and anytime. In the net system, users can access the internet by using computer, or in the kitchen or when shopping. At the same time, everywhere sensor network becomes the infrastructure of smart city to connect all parts of one city. Information infrastructure will connect the facilities of water, electricity, gas, roads and other to construct city infrastructure to meets the needs of connection between people and things.

B. *Precise, accurate, visible and reliable sensing hub intelligently scheduling urban elements*

Information technology is an important method for the urban operation and management. Precise, accurate, visible and reliable sensing grid intelligently schedules all the urban elements and supports urban operation being safe and reliable. Internet, things of internet and cloud computing construct the key intelligent information infrastructure for people and things and make the widely distributed sensors, RFID and embedded system have the ability of sensing, computing, storage and implementation to improve the intelligence, visualization and

precise for urban operation. With urban management net involving community, family and individual and connecting with the management systems, such as population systems, urban management net will cover all people and things, which will make sense grid schedule urban elements intelligently.

C. *Scientific, green and convenient digital living*

Extensive application of information technology constructs a digital living environment, and digital living will become common mode for people.

Remote video communication, online shopping, remote medical care and other scientific, green and convenient digital living will come true.

New generation digital products, such as smart appliance, digital TV, next generation mobile and multimedia device will become living necessities.

Emerging digital service can meet the needs of medical care, education, entertainment, domestic service and so on to make a convenient living.

All the appliances can be connected to communicate and exchange information, and controlled conveniently, which make living more intelligent and green.

Digital living is becoming new consumption hot spot, and driving force of people's comprehensive development and changing of consumption pattern.

D. *Virtualization, individuality and Equalization of social services*

Next new information technology will be used in some public service fields, such as medical care, education, to form ubiquitous public service environment.

The information systems of urban departments about water supply, gas supply, electricity supply, telecommunication, bank and others will be gradually integrated to construct public service information network to provide simple, timely, convenient living service.

The public service system covering urban and rural areas and having perfect functions and rational layout, is narrowing the digital gap between urban and rural with common service mechanism to promote the equalization of education, health care and other resources.

E. *The urban economy: digital economy with dematerialization, credibility and low-carbon will be booming.*

The most economy driving force of smart city is creation and utilization of knowledge. So high-tech and modern service industry of intensive knowledge and technology is the most important pill of smart city. E-commerce of safe, convenience and low carbon will be the major business transaction form of government, enterprise and personal. Cyber culture has become the most important constituent factor of digital economy. Cyber culture makes human entertainment shift from traditional media, cinemas and others to cyber space without any space limitation to improve digital economy.

F. E-government, transparent management, seamless are the base of harmony society

Government of high efficiency, transparency and seamless is the direction of government reform, and e-government will become the main form for government to implement the functions.

E-government promotes the innovations of government management, such as constructing process oriented management to reduce management, raise efficiency and reduce cost. Opening government information to public will help to establish an honest and upright government.

ACKNOWLEDGMENT

This paper is supported by Nation Natural Science Foundation of China (Grant No.70172014)

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