

Smart City and the Applications

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Abstract—Based on the “digital city”, “smart city” is widely used in daily livelihood, environmental protection, public security, city services and other fields. In this paper, we mainly focus on recent research and the concept of “smart city”, summarizing the relationship between “smart city” and “digital city”, putting forward the main content of application systems as well as the importance and difficulty of the construction of “smart city”, and making a brief statement of the influence of developing smart city in China.

Keywords—digital city; smart city; smart planet; the Internet of Things

I. INTRODUCTION

November 6, 2008, in New York on the Foreign Relations Council, Samuel Palmisano, IBM CEO, made a speech, releasing “Smart Planet: the Agenda of the Next-generation Leaders”, and explicitly putting forward the concept of “smart planet”. January 28, 2009, in the “round table”, hold by the U.S. business leaders, Samuel Palmisano again putted forward the concept of “smart planet”, which has received a positive response from Obama. In the same year, on February 24, during the 2009 IBM forum, D.C. Chien, the CEO of IBM in Greater China, announced “smart planet” as the latest strategy. August 7, 2009, when Premier Wen Jiabao inspected the institute of the Internet of Things in Wuxi, he proposed that in the development of sensor network, we need to plan for the future early and make breakthroughs in core technology early, reading China through “the Internet of Things”.

Smart city, the important strategy of IBM, mainly focuses on applying the next-generation information technology to all walks of life, embedding sensors and equipment to hospitals, power grids, railways, bridges, tunnels, roads, buildings, water systems, dams, oil and gas pipelines and other objects in every corner of the world, and forming the “Internet of Things” via the Internet. Then we can integrate the Internet of Things through super computers and cloud computing. In this case, people can manage production and life in a more meticulous and dynamic way, achieving the state of global intelligence, and ultimately reach “Internet +Internet of Things =smart planet”. [1]

These years, with the concept of “smart planet” being putted forward, smart city, smart grid and smart enterprises have been proposed as important parts of smart planet successively. Smart city, as not only a typical application of

smart planet, but also one of the most popular topics and the most cutting-edge issues, has caused widespread concern. In recent years, from London to Taipei, from New York to Singapore, one by one, the construction-project of smart city (originally known as the wireless digital city or wireless city) is the same as the spark, spreading around the world.

II. SMART CITY

“Smart city” is defined by IBM as the use of information and communication technology to sense, analyze and integrate the key information of core systems in running cities. At the same time, smart city can make intelligent response to different kinds of needs, including daily livelihood, environmental protection, public safety and city services, industrial and commercial activities. [2]

In short, “smart city” is the actual approach of “smart planet” applying to specific region, achieving the informational and integrated management of cities. It can also be said to be an effective integration of smart planning ideas, smart construction modes, smart management methods, and smart development approaches. Through the digital grid management of urban geography, resources, environment, economic, social and other systems, as well as the digital and informational processing and application of urban infrastructure and basic environment, we can achieve intelligent urban management and services, thereby promote the more efficient ,more convenient and harmonious operation of modern cities.

The structure of smart city includes perception layer, network layer and application layer, which can make the future world increasingly appreciable and measurable, increasingly interconnection and interoperability and increasingly intelligent. [3] Figure.1 shows the technical architecture of smart city clearly.

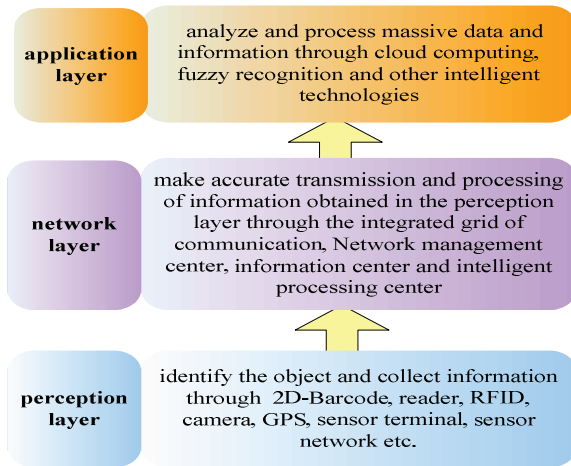


Figure 1. Technical Architecture Diagram of Smart City

III. RELATIONSHIP OF SMART CITY AND DIGITAL CITY

Digital city refers to taking remote sensing (RS), global positioning system (GPS), geographic information systems (GIS) and other spatial information technologies as the main means, constructing geographic information framework of digital city, building urban geographic information platform for public service. And through the construction of infrastructure, we can complement the development and integration of all kinds of geographic information, and achieving the network, digitalization, intelligence of urban economy, social, ecology and other aspects of each operation.. [4]

Smart city is on the basis of comprehensive digital city, establishing visual and measurable urban management and operations with intelligence. The idea is that sensors are equipped to the various objects to form the Internet of Things, and achieve the integration of the Internet of Things through super computers and cloud computing. All in all, smart city is the product of digital city combined with the Internet of Things. Figure.2 shows the relationship of smart city and digital city.

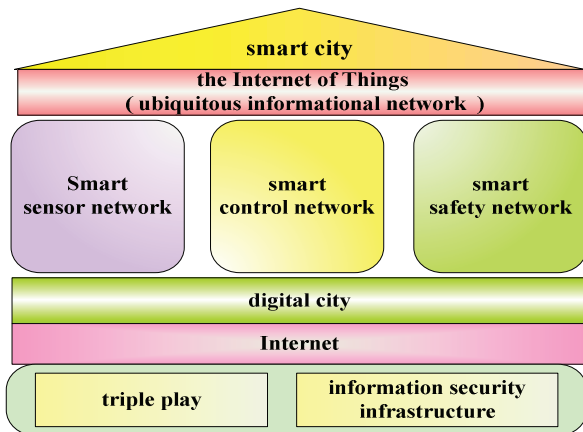


Figure 2. Relationship of Digital City and Smart City

IV. MAIN CONTENT OF THE CONSTRUCTION OF SMART CITY APPLICATIONS

Smart City will be the future trend of urban development. Generally, the construction of smart city can be divided into three levels, including the construction of public infrastructure, construction of public platform for smart city, the construction of application systems. In this three-level, the construction of application systems is particularly important, and has earned great concern across the country. Currently, in addition to defense and national security applications, smart city has been typically applied to various aspects. Figure.3 shows some typical applications.

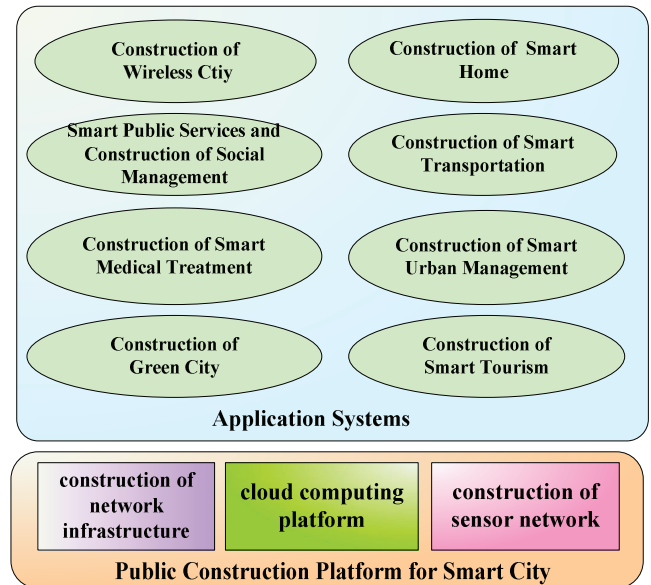


Figure 3. Construction Frame of Application Systems for Smart City

(1) Construction of Wireless City

On the basis of powerful fiber-optic network and the technology of Wi-Fi, Mesh and WiMAX, with further extension, wireless broadband network can be built. At the same time, wireless broad base station will cover the whole city. And it can provide many functions of urban management and service systems for the public, business, foreign visitors, tourists and government agencies with its bandwidth. The functions include mobile wireless video surveillance, mobile video conferencing, mobile dispatching emergency response, and emergency telecommunications. [5]

(2) Construction of Smart Home

Sensor devices, including radio frequency identification devices, infrared sensors, global positioning system, laser scanners and so on, can be combined with the Internet to form the Internet of Things. Then all the items in life can be taken as a terminal to be brought into the network, achieving the centralized and remote control of electrical and mechanical equipment through the interaction of various networks and terminals, which can be convenient to user identification and management.[6] For example, the realization of smart home can be convenient for us to achieve the intelligent control of lighting and electrical appliances, as well as receive the intelligent notification of home alarm messages. At the same

time, whether indoors or outdoors, we can benefit from the information technological achievements of smart city.

(3) Construction of Smart transportation

According to their needs and traffic situation, every city can take good advantage of sensor network, the Internet of Things and other technical means to change the traditional transport system, and establish the smart traffic management system, including adaptive traffic signal (automatic control of traffic lights according to flow time) control system, urban traffic control system and so on. At this point, the smart traffic management system can achieve the integration of urban planning, construction, management and operations, and provide comprehensive support for other subsystems of smart urban system.

(4) Smart Public Service and Construction of Social Management

In daily life, for people's complaints, requests for assistance, personal management of social affairs and other aspects, we can establish a social service system, which can cover the intelligent management of the whole city and market operation. And on this basis, we can provide basic platform services for urban comprehensive planning, emergency response, community management, and turn the government into a one-stop service system. In this case, the government can collect and analyze real-time data in urban areas, providing more rapid and agile service to the public. At this point, the public can upload information by phone, PDA, personal computer and DV, and achieve real-time query of affair-state. [7]

(5) Construction of Smart Urban Management

Based on the ubiquitous network in the future city, we can make use of 3G, wireless network, the next generation of wireless networks with broadband or the future 4G network. At the same time, through private network of e-government, we are able to achieve the interoperability of supervision center, command center and functions. In the private network, it can be possible to transfer data, work together, and form the core of the urban management system, achieving seamless management. [8]

Smart city management can achieve the management and service of urban grid. In this case, it can bring us effective management and service of urban infrastructure, population and events through intelligent collection and analysis of data.

(6) Construction of Smart Medical Treatment

With great potential to be applied into smart medical treatment, the Internet of Things can help hospitals to achieve the smart medical care and intelligent management of medical materials, and support the digital collection, processing, storage, transmission and sharing of internal medical information, equipment information, drug information, personnel information and management information. Besides, it can also meet the needs of intelligent management and supervision in medical information, medical equipment and supplies, intelligent management and supervision of public health, solving so many issues, for example the weak support of health care platform, the overall low level of medical services and the medical safety hazards. [9]

(7) Construction of Green City

Within the city limits, we can achieve the networking and interoperability of various systems posed by different devices, and make comprehensive use of various resources of monitoring and alarm to establish a new urban model and a system of green city. With the technological platform, we can achieve not only the networking, interoperability and mutual control of various devices and systems, but also the collection, transmission, storage, display and control of audio, video and alarm information. At the same time, it can also achieve the linkage with the alarm system, and provide data interface to other systems.

(8) Construction of Smart Tourism

Smart tourism is the only way to travel information. It should be based on the existing tourism information and infrastructure, taking good advantage of digital information and the Internet of Things to achieve the establishment of a set of solutions, which can consider and fulfill the management and tourism-related tasks, such as tourism online services, management of customer relation, management of operational area, development of domestic and overseas tourism market, intelligent management system of monitor, collection of tourism information and forecast of tourism development. Moreover, based on the integration of hardware and software platform for information and services of smart city, smart tourism can be taken good advantage of to fully integrated tourism market, tourist attractions, government departments and relevant information and services of enterprises to promote the development of tourism.

V. KEY AND DIFFICULTY OF CONSTRUCTION OF SMART CITY

With the increasing needs of urban management, construction and operation in reasonable planning of urban space and function layout, detection of incident, emergency response and public information services, the construction of smart city is facing great difficulties, including the follows:

(1) Management, Integration and Release of Massive Urban Spatial-temporal Data

At Present, the existing data sources of digital urban information systems are still too simple (mainly basic remote sensing, mapping data and three-dimensional model of urban street), and often appear in the style of simple query and analysis of data and the performance of three-dimensional visualization, without taking good advantage of the multi-source and multi-temporal data to make high spatial and temporal analysis to assist decisions on urban management. Particularly, in current urban information systems, the modeling of temporal data is still weak. The data structure and organization of multi-temporal data existing in the database is a quasi-static solution, and it cannot meet the practical needs of digital real-time updates, historical reconstruction and future prediction. Therefore, the key of static digital city developing to smart city is the breakthrough of integration of multi-source heterogeneous urban information, urban address code, management of urban infrastructure and components, quickly update of online spatial data, multi-dimensional visualization

of spatial data, and the construction of multi-dimensional temporal data model with flexible structure and adaptability.

(2) Large-scale space-time information and efficient services

Spatial information of smart city comes from a wide variety of sensors, controllers and computing terminals, and is maintained by computers and storage nodes of different departments, so how to manage and coordinate the equipment with various structures and wide-area distribution is a great challenge of constructing service platform. On the other hand, information on smart city contains not only a large amount of structured data, such as temperature, voltage, geographical coordinates and so on, but also a lot of unstructured data, such as pictures, audio and video files. And whether we can store and manage the huge amounts of data effectively will directly affect the performance of information services. Finally, smart city is related to intelligent analysis of urban information, decision support, public affairs and many other applications. Besides, a large amount of real-time tasks also need to respond to user requests quickly, which has higher demands for information services. For the above character of spatial information services and unsolved problems, we need to study smart urban information service system at all levels, proposing effective efficient methods, which is a wide integration of internet devices, mass data and large numbers of users.

(3) Model of Heterogeneous Sensor Data and Expression of the Internet of Things

As the important basis of developing smart city, the Internet of Things is also an important part of smart city. But as the demands in sensor platform, observation mechanisms, processes, location information and technical requirements are different, how to build models describing sensor information, including location attribute, observation object, time and status is a difficult technical problem. As the urban affairs are perennial gradual change and instantaneous mutations, how to observe data and detect abnormal events effectively is also a difficulty.

(4) Technology of Intelligent Analysis and Decision Support

With diverse sources and so many related departments, spatio-temporal data can achieve real-time update quickly. So how to create a unified understanding of data semantics, and extract new knowledge based on specific cycle data and real-time data is a technical difficulty in establishing knowledge base of smart city. And the specific implementation needs the effective support of municipal departments. At the same time, the extraction of knowledge should be based on manual extraction, and supplemented by automatic computer analysis. Through the accumulation of knowledge, we can analyze the law, establishing an effective intellectual model and developing tools of knowledge extraction. Besides, we can accomplish the extraction and update of real-time knowledge, which is based on automatic analysis of computer.

(5) Sound Information Service and Shared policy mechanism and legal protection

As smart city involves many sectors and industries, we need to break trade barriers so as to achieve information sharing and information exchange between traffic, public

security and other departments. We also need to learn from developed countries in information sharing and services, establishing coalition mechanism of national spatial information sharing and services, and accomplishing sound information services and sharing policy mechanism and legal protection to arouse the enthusiasm of departments and industries so as to try for broad social partition.

VI. VALUE AND OUTLOOK OF SMART CITY

Internationally, it is a good opportunity for China that smart planet starts with smart city. At present, China has achieved good development in information technology, and as to the technology covered in smart planet, including sensor technology, network technology, physical networking technology and intelligent information processing technology, our country have certain R&D infrastructure and industrial capacity. On this basis, we should combine our economic and social development needs to increase the investment in material, technical, and personnel infrastructure. At the same time, we should select a number of developing priorities in a planned way, for example smart transport, smart grid, deploying as soon as possible, achieving a more thorough sense, more comprehensive interconnection and more intelligence.

In terms of our country, with the development of the Internet of Things, people's daily life will be changed dramatically. At the same time, it also brings us to the development of smart city, which is based on the Internet of Things. In the encourage of global trend of smart city and national policy, a numbers of cities, for example Beijing, Shanghai, Guangdong, Wuhan, have taken smart city as an important research, and participated in the construction of "Smart City" and "reading China", trying to stand out in the future economic competition with the layout of the Internet of Things.

REFERENCES

- [1] Yongmin Zhang, Interpretation of Smart Planet and Smart City [J]. CHINA INFORMATION TIMES, 2010(10):38-41.
- [2] Honghua Qin, Hanqing Li, Xia Zhao, Development Status of Domestic and Foreign Smart City, 2010(9): 50-52.
- [3] Yong Liu, Rongxu Hou, About the Sensing Layer in Internet of Things [J]. Computer Study, 2010(5): 55, 62.
- [4] Yongmin Zhang, Zhongchao Du, Present Status and Thinking of Construction of Smart City in China [J]. CHINA INFORMATION TIMES, 2011(2):28-32.
- [5] Zhiping Wang, The Application of Wireless City Technology in Public Administration, Journal of Chinese People's Armed Police Force, 2008, vol. 24.
- [6] Dae-Man Han, Jae-Hyun Lim, Design and Implementation of Smart Home Energy Management Systems Based on Zigbee [J]. Consumer Electronics, 2010, 56.
- [7] Kortuem, B., Kawsar, F., Fitton, D., Sundramoorthy, V., Smart Objects as Building Blocks for the Internet of Things [J]. Internet Computing, 2010, 14(1): 44-51.
- [8] Krassimira Antonova Paskaleva; Enabling the Smart City: the progress of City E-governance in Europe [A], International Journal of Innovation and Regional Development [C], 2009: 405-422.
- [9] Qin Xue, Smart Healthcare: Applications of the Internet of Things in Medical Treatment and Health. Information Construction. 2010(5):56-58.