Digital City—the 21 century’s life style

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Abstract: Digital City is the crucial point of Digital Earth. In this paper, the author gives the concept of Digital City and puts forward a three-layer architecture of Digital City system, which includes foundation layer, application layer and decision-making layer. System structure and module functions of this architecture are introduced in detail, and that the influence of Digital City to our future city is also discussed.
Key Words: Digital City, Urban Sustainable Development, Architecture of Digital City

21 Century is the age of knowledge economy. The aggregation of computer communication and information electrical appliance will build the affordable and comparatively popular information infrastructure, which will infect various fields in our society and economy and become the lever for the transition from an Industrial society to a knowledge society. If the developing country could catch this opportunity through efficiently developing manpower resource and creating the national innovation system (technology innovation, mechanism innovation, consciousness innovation), it will smoothly enter into the knowledge society and its people will enjoy the “digital life”. In the foreseeable future, the development of digital technology and digital economy will accelerate the globalization. Whether region, nation, community or individual will confront a series of choices, adapt to the digital life or not. With the challenge coming, Digital City is becoming the informationalized substance carrier for digital exist and technology carrier of living behavior.

1. The research signification of Digital City
The thought of Digital City come form the stratagem of Digital Earth. The essence of Digital Earth is to design and construct the next Global Information Infrastructure, which makes use of the Web-based GIS technology to organize and manage the data related to the geographical location coming from various fields of society, economy and finally forms the three-dimension visual global digital nervous system. Through the function of information inquiring, management monitoring, decision-making supporting, people could rapidly and efficiently know all kinds of information about our planet, improve the mode and quality of life, harmonize the relation between human and environment and realize global social and economical sustainable development. Considering the stratagem of technology, economy and military affairs, all the countries have abroad attentions to the Digital Earth as soon as the concept of Digital Earth was put forward and is becoming the competitive focus in the field of high and new technologies. If we say that “Digital Earth” is constructing the earth’s nerve network for our existence, Digital City is the nerve cell in the nerve network and has the crucial status. City has the characteristic of dense population, expedient traffic, huge information, prosperous economic and culture, and that it is the important location to create civilization of the human substance and spirit, the radiant point and assemble location of human civilization. The development of Industrial Society accelerate the
urbanization and bring a series of complicated problems, such as population explosion, resource shortage, environmental pollution and instability of economical development. At the present time, there are 668 cities in China. Some experts predict that in the coming 15 years, China will have more than thousands cities, the level of urbanization will reach about 50%, the urban population will reach more than 6 hundred million. Apparently, the recent urban planning, construction and management have difficulties to meet the need of city’s development. In the future omnipresent computer network world, many activities of economy, society, politics and culture will be shifted to the computer space. So we should radically redefine the concept of city.

The design and construction of Digital City will explore the new mode for the city’s development. Based on the Digital City, the concept and structure of city will have crucial change. The urban population, industrial distribution and economical mode will have radically transformation. The efficiency of reduced. So the Information Industry will become the new economical added value field. Building Digital City will push the transition from an Industry economy to an Information Economy, accelerate the stratagem of Digital Earth to come true, and finally will provide people a sustainable social information living space.

2. Preliminary Research on Architecture of Digital City

2.1 The concept of Digital City

Nowadays there is no uniform concept of Digital City. Some think it just a kind of web site that has more hyperlinks and releases much urban information, but more people think it as infrastructure digitized of city. With the development and extension of Digital Earth’s idea, Digital City is capable of providing not only the ideal technical mechanism but also people’s living space to meet the needs of regional, national and global sustainable development. Therefore, Digital City is better defined as a social information living space for city residents on the basis of the urban Spatial Information Infrastructure. By using the crucial technologies of Digital Earth such as data mining, knowledge extraction and the technology of Virtual Reality, the extensive and multi-source spatial information in Digital City is integrated and managed effectively. Eventually Digital city will provide not only virtual interface for the public and enterprises to realize “Being digital” [1], but to assist the government make integrated decision for the urban management, such as planning, municipal operation, community management and emergency response.

2.2 The Construction of Digital City

Currently, global sustainable development is a major issue confronting everyone on this planet. “Digital Earth” is considered as the ideal platform to develop and implement the right solutions. Study on Digital City, the crucial nodes of digital nervous system of digital earth, is great moment.

2.2.1 Architecture of Digital City system

We propose the three-layer architecture for Digital City, which are the fundamental layer, the application layer and the decision-making layer.

(1) The fundamental layer

In this layer, the spatial information infrastructure platform of Digital City is provided, including multi-resolution, multi-dimensional spatial database, Metadata, high-speed networks, clearinghouse, corresponding standards and criterions of spatial information infrastructure, as well as the spatial information resource and knowledge resource.
The key research contents in this layer are as follows:

(a) The construction of information model
The operation target of Digital City is data of multi-source, multi-scale, multi-resolution, multi-time phases, which are related to various of urban resource, environment, society and economy. The huge amount of the data has complicated interrelation with each other. Based on the research of complexity and dynamic characteristic of City, it is necessary to construct information model of Digital City to organize and represent the structure, character and interrelation of urban information.

(b) The technology of high-speed networks
There are thousands of different organizations in Digital City connected by network that will deliver the interactive communications, secure business transactions and trusted public data records. Driven by the explosive growth of Internet traffic, the broadband networks are necessary to be constructed, which call for a versatile, flexible, extensible architecture of network.

(c) Urban spatial information Clearinghouse and Metadata
Urban spatial information Clearinghouse is a kind of distributed and non-centralized network for data management and data exchange. It may provide detail directory services supported by Metadata, as well as supports the spatial information hyperlinks. For the user, the Clearinghouse will provide a sharing information platform to deal with various information for their route navigation, real-time weather inquiry, network shopping, network education and so on.

Metadata is “data about data”. It is used to describe the content, quality, representation model, spatial reference, management model and other characteristic of data set. It may provide the information for data directory or urban spatial information Clearinghouse. It is a main solution of implementing spatial information sharing in Digital City.

(d) The study of the laws and standards for Digital City
Urban spatial information infrastructure is the important component of NSII. Relevant the laws and standards are necessary to accord with the NSII, which includes the standard of spatial metadata, Index System and Classification Encoding, Spatial data Transfer Standard. In addition, laws and policies for data sharing and information security are important to keep Digital City develop smoothly.

(2) The application layer
The application layer aims to manage and integrate the spatial information derived from nature, society and economy related Digital City. Furthermore, the mechanism and the developing tools are provided to transform the information resources into practical application.

The application layer includes two parts:

(a) Integrated model base and auxiliary model methods:
The model system can be divided into three levels: integrated model system, sector model system and auxiliary model system.

Sector model system covers various professional models from different sectors in Digital City. According to their application, these models are classified into population model, environmental model, resource model and economic model. Assisted by auxiliary model methods, these models are available to be optimized and integrated to support relevant analysis and decision-making such as environmental monitoring, disaster prediction and so on.

(b) Professional subsystem and Functional subsystem:
There are various information services and applications in this layer, which are implemented by Professional subsystem and Function subsystem. Different application systems may have different models, functions and interaction modes. The application of these subsystems determines the degree of the data available to be understood and used. The construction of the systems and the development of relevant techniques will directly affect the scientific research of the Digital City.

Professional subsystem covers a group of Web-based geographical information systems, such as city planning subsystem, urban transportation management subsystem, and urban environmental management subsystem. It should face the concrete application. With the virtual reality technique and WebGIS technique, user can get three-dimension, real-time, dynamic and visualized information.

Functional subsystem, consisted by Electronic Government, Network Education on Internet, Electronic Finance, Electronic Business and Network Hospital, Emphasizes the services for the urban government, enterprises and public lives. Electronic business is very important to the business of Digital City. Electronic Business will provides optimum solution in the management of business matters, such as management of rapidly increasing products and shops, interactive communication with customers, even planning, payments, inventory management, order processing, and deliveries.

Some research contents in this layer is:

(a) Web-base GIS research
Research and development of GIS have being experiencing the structural and organizational changes from personal desktop GIS or small group department GIS to enterprise level GIS and Web-based public GIS, from integrated one-tier structure, two-tier client/server structure to three-tier browser/server structure. Web-based, interoperable and public-participated open GIS will become one of the most important software platform based on spatial information in Digital City.

(b) The research about Virtual Reality
Virtual Reality is the aggregation of many technologies such as computer graphics, Artificial Intelligence, the technology of man-machine interaction, sensor technology and so on. VR system will let user have a sense of immersion achieved by a 3-dimendion visual scenario. Through some equipment such as head mounted displays, user can experience and interact with the virtual world.

(c) The research about Interoperability
Interoperability is very crucial technology in Digital City. The standard of Interoperability given by the Open GIS Consortium will help geographical information generated by one kind of application software can be read by another.

(d) The research for integration and optimization of sector models
Currently, there are many mature application models in professional model bases. Moreover, urban relevant management is the procession of integrated decision-making over every sector of city. It is the problem on how to integrate and optimize these models for decision-making of urban sustainable development.

(3) The decision-making layer
The management and decision-making is the key link in the source of urban development. The strategy of urban sustainable development will not have practical sense only if the urban optimized plan is transformed into relevant policies to direct urban economic activities. It is clear that the procession of implementing the strategy of sustainable development is the procession frm
analysis and evaluation, to plan, decision-making and management. Each step in it needs the support and assistant of urban spatial information infrastructure and the spatial information systems of Digital City. Finally, the steps about the urban developing plan, economic and social developing plan, macro-regulation and macro-control for urban environment, economy and resource will be carried into execution.

The key research contents are as the follows:

(a) the construction of the indicator system of urban sustainable development

Urban sustainable development is to realize the aim of sustainable development of economy, environment and society, and that it is the symbol of interaction and harmonious development. To evaluate urban sustainable development is related to every aspect of urban economy, environment and society. The indication system of urban sustainable development is crucial in evaluating the state and degree of urban sustainable development.

(b) the research of the strategy of urban sustainable development based on Digital City

Implementing the Digital City will bring great change and challenge to urban development. It will accelerate urban economy transition from an Industrial Economy to an Information Economy, which will change people life style and bring about many changes on urban economical to be implemented is the question we need to answer.

The three-layer architecture for Digital City is supported with each other. Each subsystem in Digital City cannot exist without the support of new technologies and information resources. By using the crucial technologies of Digital City, the public information living space for urban life will be constructed in Internet and WWW circumstance. Digital City will offer the prospect of better decision and improved economic growth, social development and environmental management.

2.2.2 The key technologies and application of Digital City

Most key technologies of Digital City and application have been mentioned in the content about the architecture of urban Digital City. They can be summarized as follows:

(1) The key technologies of Digital City are:

(a) the research of Digital City Framework and Architecture

(b) the research of Digital City standard and criterion

(c) the research of how to construct the Internet data center in Digital City

(d) the research of the platform of Electronic Commerce in Digital City

(e) the research of decision-making supporting system for Digital City Sustainable Development

(2) The applications of Digital City are:

(a) Electronic Business: include electronic market place, electronic trade, virtual market management, etc.

(b) Electronic Finance: include Electronic Bank, virtual stock exchange, electronic forward business and Electronic insurance, etc.

(c) Electronic Entertainment: include virtual movie, virtual theatre, virtual tour, etc.

(d) Network Education: include virtual classroom, virtual laboratory, virtual college, and virtual library, etc.

(e) Network Hospital: include consultation of doctors online, etc.

(f) Electronic Government: include meeting online, network municipal operation, etc.

(g) Integrated application: include intelligent traffic planning and management, virtual city
3. The influence of Digital City to our future city
Digital City gives us a completely new concept about our future. Accompanied with the popularization of information technologies and construction of spatial information infrastructure of Digital City, the transition from an Industrial Economy to an Information Economy will have a profound and lasting effect on urban economy and society. The influence on the future city is as the follows:

(1) Digital City will cause the change on the life style and work mode of people
Many organizations in Digital City are connected with high, efficient and ubiquitous network so that the long-distance interaction between them will ignore physical distance. People can achieve Electronic Shopping, Electronic Entertainment, and long-distance work at home. The physical presence a corporation is no longer a requirement. Working at home will become popular. Large corporations will adopt the long-distance work style to arrange their production. Because people’s outdoor activities decrease, resource consuming, traffic and air pollution will decrease. The sphere of people activities will be extended, but the relationship between the people of neighbourhood will be weakened.

(2) the industrial structure of city will be regulated
Information Industry will be the main sector in the procession of the development of urban economy, and that Information Economy will replace the Industrial Economy. In this course, Information and knowledge, technologies will be fused so that industrial competition, modern commercial trade and service trade will strongly rely on the Information produce and application, which drives the service trade to develop rapidly.

(3) Social division of labor will be changed and new industrial space will take shape.
The proportion of white-collar workers in work force will be much more than blue-collar workers because of the effect of Information Economy. High tech cottage communities, which include high intelligence developing, information producing and information services, will begin to emerge. It will make the urban space change and form some different function regions.
In addition, the most important function of government department in Digital City is to make good public policies to tap the latent power of the information technologies, and coordinate the interrelation between urban sectors.

4. Conclusion
As the important component of the strategy of Digital Earth, the study on Digital City has great significance. Digital city will provide the good solution and support for the urban sustainable development. The construction of Digital City relies on the improvement of information technologies, computer science and technologies and will not be successfully accomplished unless government, industry and academia make the cooperation and joint efforts. The study and application on Digital City in China are in the initial stage and need to make a further effort in the future.

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