A Study on the Service Method of Parcel-Boundary Information Suitable for the Ubiquitous City Operation

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SUMMARY

Ubiquitous City (U-City) is a new urban form, created by the convergence of information and construction technologies, and a newly emerging market, expected to drive the rapid growth of information service industry. Therefore, Korea Cadastral Survey Corporation (KCSC) must develop the plan of servicing cadastre information to U-City and launch the plan quickly, to boost its standing as customer centered digital cadastral service corporation and to expand its business scope.

This study aimed to define cadastre information available for U-City and present the process methods for information service and the plan for proper information provision.

Based on the accumulated result of research, this study built a model that can service the cadastre information to U-City. The study concluded that it is desirable to deploy a system which can process and provide cadastre information (parcel-boundary) to CUIC (City Unified Information Center) supervising overall affairs of U-City and continue to manage and update the information.

요 약

U-City 는 정보기술과 건설기술의 컨버전스로 탄생한 새로운 도시형태이며 정보서비스 산업의 급성장이 예측되는 새로운 시장이다. 따라서 대한지적공사가 고객중심의 디지털 지적정보 서비스 기업으로서의 위상을 높이고 사업영역을 다각화하기 위해서는 U-City 에 지적정보를 서비스하는 방안을 연구하고 이를 신속히 사업화하여야 할 것이다.

본 연구에서는 U-City 에서 활용가능한 지적정보가 무엇이고 정보서비스를 위해 필요한 처리방법이 무엇이지, 또 적절한 공급방법은 무엇인지 그 방안을 제시하고자 하였다.

본 연구를 통해, U-City 를 총괄하는 도시통합정보센터에 지적정보(필지경계)를 처리하여 제공하고 지속적으로 관리하고 갱신해 주는 체계를 추진하는 것이 바람직하다는 결론을 낼 수 있었다.

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1. INTRODUCTION

Korea has enjoyed remarkable growth of economy. Its high economic standard, along with diverse demands of information and world-top level IT infrastructure, provides a perfect environment for a ubiquitous city. Backed by such advantages, the ministry of information and communication established "U-Korea basic plan" in March 2006, to build a foothold for reaching 20 thousand US dollar GNP and to secure national competitiveness. U-Korea basic plan presents the development of ubiquitous technology and its policy direction and established the roadmap to support U-City operation for high-tech intelligent development of land.

In January 2007, the ministry of government administration and home affairs established "the basic plan for U-Local informatization" to bridge the gap of information between regions and achieve the balanced land development. The ministry of construction and transportation also plans within year 2007 to enact "City construction supporting law" providing the plan for support of U-City construction, project execution plan and operation and support of U-City. Likewise, government agencies adopt diverse policies for U-City competitively.

Therefore, this study proposes to search which cadastre information can be used and utilized for U-City, in which form the information should be processed and which service model is suitable for the information service. In addition, the study is designed to establish an appropriate system to process and distribute cadastre information for the cadastre information service project.

Since a model for U-City has not been deployed or operated successfully yet domestically and aboard and requires a long development time and large amount of investment, it needs careful consideration in determining and proceeding the policy for U-City. Thus, diverse researches have been conducted to find appropriate deployment method and service model for U-City in the IT and city construction field. National Information Society Agency (NICA) published in 2005 "Study on U-City Application Service Model", "Propose of Korean U-City Model" and "Research on Current Status and Demand of Ubiquitous Service" and KRIHS (Korea Research Institute for Human Settlements) conducted "National Strategic Research for Implementation of U-City." In addition, ETRI(Electronics and Telecommunications Research Institute) and KICT(Korea Institute of Construction Technology) conducted survey on demand, analyzed the trend and proposed the policy for U-City.

Therefore, with reference to the above mentioned researches and studies, this study extracted items necessary to service the cadastre information to U-City.

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1. CURRENT STATUS OF UBIQUITOUS CITY

1.1 Concept of U-City

U-City is a new urban form, where ubiquitous computing technologies are applied to improve the life standard of citizen and the efficiency of city management. That is, U-City is a city where the quality of citizen's life is improved. Because sensors are placed around the city and the whole city is connected via network, desired information can be communicated anytime anywhere, regardless that the citizen recognizes it or not.

The ubiquitous computing refers to the environment where computing technology is implemented anywhere and anytime. Mark Weiser used the word of ubiquitous computing first in his book, "Study on Easy to Use Computer (1998)" when he was in XEROX PARC (Palo Alto Research Center). Ubiquitous computing means the computing function is carried out even though people cannot recognize it because diverse types of computers are embedded in people, objects and environment and they are connected with each other. The term, "ubiquitous" derived from Latin word, meaning "God exists everywhere and always." In Korea, the word started being used widely when newspapers introduced the vision of U-Korea in 2002.

As its basic directions, U-Korea basic plan presents the implementation of society based on safe ubiquitous technologies beneficial for all citizens, warm U-Korea for all citizens, U-Korea easy and convenient for everyone, harmonious U-Korea and value creating U-Korea, and describes the future society of year 2015, where ubiquitous technologies are implemented fully.

That is, U-Korea basic plan aims for 1) government serving people with customer and field centered administration service, 2) intelligent land management with watertight monitoring of social infrastructure and improved response to situation, 3) strengthened industrial competitiveness with synergy from the combination of all industries, 4) implementation of safe society with preventive policies and 5) implementation of advanced social welfare with customized service, from the perspective of government, land, economy, society and individual respectively.

2.2 Prospect of Information Service Market

U-City is expected to innovate the functions of a city and improve the convenience and quality of lives in the city. In addition, large IT demand will be created from the convergence of new town construction and ubiquitous industry. Compared with the public service such as electricity and gas supply, high-tech information network delivers new additional services and contents and creates higher values. That is, U-City infrastructure can be utilized to create various value added services such as U-Home Network, U-Health and U-Education. U-Home Network is expected to grow by 32% annually, including intelligent information related devices and domestic appliance, home network and ubiquitous computing. When U-Health penetrates into the lives of citizen in full swing, its domestic market is expected to reach 1

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billion US doller in 2010 and the market of U-Education is also expected to 4.4 billion doller in the same year(Refer to Figure 2-1).
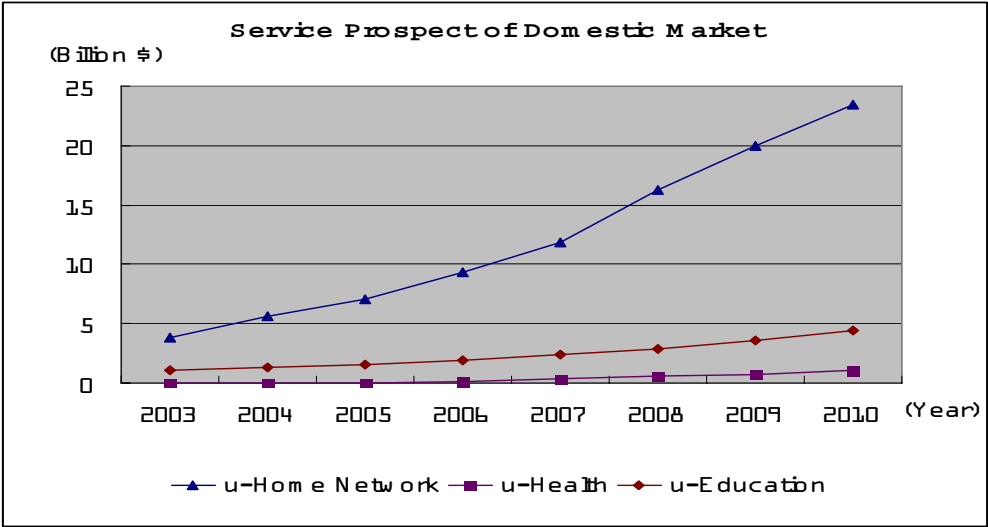

Figure 2-1: Prospect of U-City Information Service Market

2.3 Status of Domestic U-City Project

Domestically, U-City is being constructed by municipalities. Some are focused on the construction of new town, called new town type and others are combined type that constructs a new town and renovates an old town at the same time. Especially, some new towns in metropolitan area such as Song-Do in Incheon, Dong-Tan in Wha-Seong, Heung-Deok in Yong-In and Unjeong in Paju lead the construction of U-City but they have not achieve tangible result yet. Although a lot of municipalities intend to construct U-Cities, their plans stick around at the level of basic plan, except Song-Do in Incheon that went into the stage of design, and detailed plans are not established yet.

Incheon is constructing Incheon Free Economic Zone(IFEZ) as the herb of international business and trade and the center of north-east Asia, which will be completed by 2020. Until now, the ISP project IFEZ is completed and the process of the construction in this area precedes any construction in any other areas. ITS(Intelligent Traffic System), home-network, remote-treatment, disaster prevention system and environment pollution management system will be also serviced in the future.

IFEZ can be divided into 3 sub-areas: Song-Do, Young-Jong and Cheong-Ra and the size of the whole area will reach 209   and total 497 thousand people will live there. The U-City plan for each sub-are is as follows:

Song-Do area will play a role as the foothold of international business and trade related to the airport and the harbor. It will be constructed as the R&D herb of future high value added knowledge and information industry such as IT and BT and the water front and the greenbelt around the area will be conserved to construct the area as culture and eco-city. Song-Do is a

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landfill, which was originally the beach adjacent to Incheon. Thus, it is advantageous not to consider existing structure or form of the city in constructing U-City there. Young-Jong area will supplement the airport function as the central airport of north-east Asia and be developed as a foothold of air transportation, including free trade area and logistics terminal, and as the leisure and tourism complex. Cheong-Ra area will be responsible for the functions of finance centered international business and attract high-tech leisure and flower planting complex as the place of rest for foreign tourist and metropolitan citizens.

In Korea and any other countries, no city has reached the stage of comprehensive U-City construction yet and services of U-City are provided with the limitation of scope and space. In foreign countries, although some have the technologies of U-City components, they have not applied the technologies to the whole city yet. Considering the overseas and domestic progress of U-City construction, Incheon is regarded as the leader of domestic U-City project. Incheon has already established U-City informatization strategy plan in 2005 and is attracting various pilot projects including construction of unified city information center. In April 2007, Incheon is selected as the city for U-City testbed construction pilot project and plans to construct integrated city information center, U-City exhibition hall and U-Traffic square as a leading U-City project by 2009.

Incheon set in concrete the basic plan of 'U-City Construction' that schedules to avail Song-Do international city IFEZ including Incheon free economy zone and reconstruction areas of old downtown of high-tech ubiquitous service by 2017 and will invest 427.3 billion KRW over 3 stages for 10 years in the construction of unified city information center, U-City exhibition hall, u-Traffic square and intelligent traffic system.

At the 1st stage(2007-2009), Incheon will deploy U-City model in core areas of Song-Do international city such as city expo exhibition hall, central park and Song-Do Convensia as the part of U-City pilot project sponsored jointly by the ministry of information and communication and the ministry of construction and transportation. The U-City model will help to collect and analyze comprehensive city information including environment, traffic and public security and contribute to implement the city management system that can control traffic signal, manage unexpected accident, provide 24 hour crime prevention and monitor and mange areas vulnerable to crime and underground/road facilities. At the 2nd stage(2010-2012), the ubiquitous service will be provided for the core areas in Song-Do international city and U-City will be constructed in Young-Jong and Cheong-Ra areas in stepwise manner, following the development plan for each area. At the 3rd step (2013-2017), U-City project will be expanded to the major reconstructed areas in the old town within the free economy zone.

2.4 Status of Overseas U-City Project

In foreign countries, the concept of U-City is not developed sufficiently. Instead, 'Digital City' is being constructed. As examples, Cyber Port in Hong Kong, One North in Singapore, MSC in Malaysia, Arabianranta in Finland, Crossroads in Denmark and technology and media free zone in Dubai can be taken. Making comprehensive analysis of such examples, they are pushing on with Digital City as a strategic cluster based on the characteristic of the

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region and their IT technology. In addition, they are in pursuit of synergy effect of related industries with the construction of a new town of information such as construction of effective network and provision of wire/wireless telecommunication service to residents. But, the information service is not sufficient still and cadastre information is not included in the service in any country.

Cyber Port in Hong Kong is a complex city of 231,000 m^2 for residence and business that was constructed as a government project from 2002 to 2007 to attract digital media industry. In the first stage, 4 business facilities, shopping center, hotel and residential facilities have been constructed in 2004 and other residential complex was constructed in 2007.

In Cyber Port, DMC(Digital Media Center) and Hong Kong Wireless IT Center play the critical role. Especially, DMC is constructed to support hardware and software for the digital media industry and move-in companies. Backed by the cooperation of school, industry and research center, DMC educates IT experts and has common devices such as motion capture system and multi media work station to support media companies. Hong Kong wireless IT center was established jointly by Hong Kong government, science technology fund and wireless telecommunication companies. It has the lab for device test, exhibition hall and training rooms. In addition, Arcade where shopping center and cinemas are located plays its role as the exhibition hall of high technologies and entertainment.

In the building, two-way kiosks are installed to provide diverse multimedia information and entertainment and internet access service and IT boards in public areas, monitors with outstanding interior design and LCD monitor in indoor garden show off the IT.

One North in Singapore is a futuristic city for medical engineering, referred to as medical city(bio-polis). Singapore government plans to invest 1.8 billion dollars by 2010 to attract researchers from internationally recognized 15 medical companies that produced great achievement in cancer, immunity and cell engineering. In addition, the One North project is constructing the herb city of medicine, culture and media, aiming to expand wide area wireless network and integrate city functions.

3. CURRENT STATUS OF INFORMATION SYSTEM

3.1 Korea Land Information System(KLIS)

KLIS aimed to deploy the system that help to solve problems in land administration reasonably, maximize the use of limited land resource and distribute the profit and value from the land fairly. KLIS was built by combining PBLIS (Parcel based Land Information System) deployed by the ministry of government administration and home affairs with LMIS(Land Management Information System) deployed by the ministry of construction and transportation.
PBLIS is a newly deployed system computerizing cadastral maps in the existing cadastral administration system that manages only the attributes of lands, forests and fields for cadastral and land administration of municipalities and LMIS is deployed separately to create cutting to

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continuity cadastral maps, manage areas and zones for special purposes and process land administration, based on topographical maps and cadastral maps. However, in 2002 the two system were integrated into KLIS according to the audit result of the board of audit and inspect and the recommendation of the office for government coordination and KLIS was expanded to nationwide 234 municipalities from June 2005 to April 2006.

Integrating LMIS and PBLIS and the menus of municipal cadastral administration systems, KLIS consists of independent systems located in individual municipalities. The common programs are installed in 1 and 2 step servers of municipalities an KLIS is mounted in the KLIS server(existing LMIS server, 2nd server of municipality and newly employed server).

By deploying KLIS, the DB for cadastre and land regulation information can be constructed and utilized in public agencies and private sectors leading GIS based information projects. In addition, KLIS enables integrated public service center to issue cadastre related document such as those for cadastral record registration and land related public petition of land usage plan confirmation on line or via a remote system.

The most important advantage of KLIS deployment is the improvement of effectiveness in land administration such as the retention of cadastral information in the ministry of government administration and home affairs and the ministry of construction and transportation. With KLIS, the changes in land registration such as division and incorporation can be updated in real time, which enables the ministry of construction and transportation to analyze various land related spaces. Thus, KLIS contributes to the reasonable land policy including prevention of property speculation as well as to shortening the process time for land administration and improving productivity of land administration.

Since KLIS can be accessed only by civil servants related to land affairs and the employees in KCSC, the public cannot access the system directly. But, the system interfaces with the portal of Onnara Real Estate Information and Real Estate Information Management System. Thus, the public can search cadastre information on the web sites.

3.2 Survey Information Management Center(SIMC)

KCSC launched 3-year plan (from 2007 to 2009) for SIMC to construct DB with digital data collected from field survey, remove duplicated survey on the same area and to manage manpower and time effectively. When SIMC is constructed, KCSC will be able to collect and process cadastre information and customize the information suitable for the need of demanding institutes as well as to distribute the information. In addition, because the flooded area trace data, the basic data for national disaster management can be also managed together, the business scope is expected to be expanded into a new cadastral survey project similar to the above mentioned data management.

In 2007, the 1st year of the 3-year plan, the survey on demand and pilot project are carried out to survey the demand of customized cadastral maps, analyze the market and present the DB standard plan for standard electronic maps. In addition, pilot DB for standard electronic maps,

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SIMS(Survey Information Management System) and the web system for flooded area trace management are under deployment. In the 2nd year, the basis of distribution will be constructed to integrate cadastral information, strengthen the functions of SIMC, develop a system preventing illegal distribution and forge electronic cadastral maps and deploy interface system for related systems and distribution system. In the 3rd year, the expansion of distribution is promoted to integrate cadastre information, complete functionality of SIMC and sophisticate the system in the center.

With the deployment of SIMC as momentum, business models will be created including customized electronic cadastral maps and the revenue structure of KCSC will be diversified. In addition, KCSC will strengthen its position as the institute responsible for flooded area trace and increase revenue with the permanent survey task. Also, as penetrating in the business of cadastre information distribution, KCSC can position itself in the cadastre field as a total solution company that supports national key industries and private sectors with cadastre information of high quality. Besides, it can be expected to achieve other effect including business innovation, cost reduction, accuracy and standardization of data.

4. UTILIZATION OF INFORMATION

4.1 Cadastre Information in City Unified Information Center

The city unified information center in U-City manages the infrastructure in the city in real time, provides public services through the interface with public information in the city and collects and analyzes city information comprehensively for the effective city. Thus, the center is responsible for the core function of U-City and plays the role as the herb of information where all information on the city is concentrated and processed. Especially, as presented in the space information application of city unified operation service, the infrastructure, environment, traffic, crime prevention/public security, disaster/accident and general public petition are monitored and analyzed on the basis of space. Among the information on space, cadastre information is the most frequently used information. Since the cadastre information contains the location of land(parcel), its boundary, land number and land category, the information can be used to search space quickly such as searching the position of moving object, location of facility and spot of accident and incident. In addition, the information can be used to search a land affected by the urban plan or public facilities so as to prevent such urban plan and facilities from infringing on private property right.

The cadastre information in the city unified information center such as the location of land, land No, land category and its boundary can be provided from the municipalities that construct U-City. It is desirable for KCSC to carry out the information management that processes the received cadastre information in GIS in the center, distributes the processed information and reflects changes in the information in real time. Although a lot of effort and cost are invested in the deployment of city information system, the system does not continue to be used because the information does not continue to be updated quickly. Therefore, to secure the reliability of information, the city unified information center should make its effort to update the information that is provided to U-City. Since KCSC is a producer of cadastre

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information through the cadastre survey, it has an advantage over other institutes in updating the cadastre information. Figure 4-1 shows the role of KCSC as a processor of cadastre information.
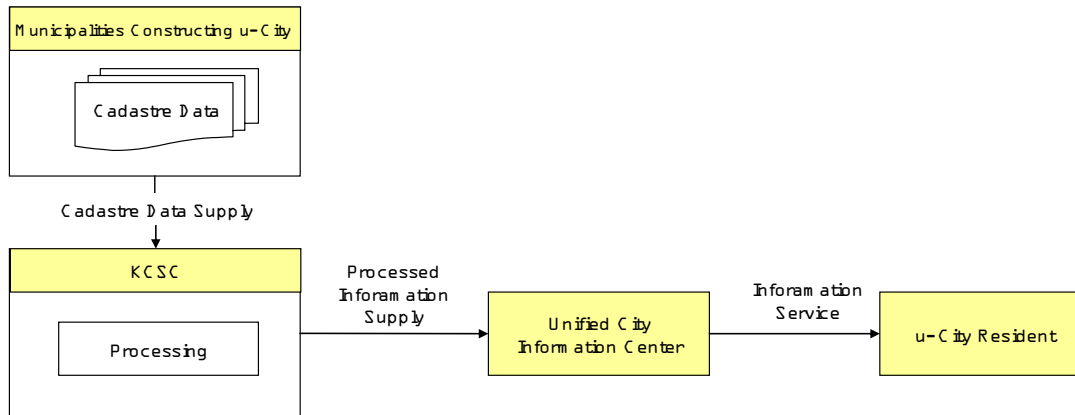

Figure 4-1: .KCSC as a processor of cadastre information.

GPS built-in cellular phone as well as u-Pole at the side of a road can be used to search the location of a user. u-Pole is a lamp post with IP wireless telecommunication module, monitoring facilities such as road and underground facilities in real time and providing intelligent city based service. Especially, the installed emergency bell and video and audio devices for pedestrians as well as CCTV can be used as the facility for safety. The information collected from precise positioning device may be displayed in the GIS in the center. That is, the accuracy of positioning information depends on the used device, technology and the individual situation. The city unified information center may collect the positioning information of high accuracy but sometimes the information of low accuracy. But, the center should provide more accurate positioning information than its collected information. Otherwise, the center may provide inaccurately analyzed information of lower accuracy than that of the information provided from a user. To provide accurate cadastre information, the center should not use the digitized and edited cadastral maps as they are. Instead, the center should process the received information as follows.

- Determine the world coordination system of cadastre reference point for U-City construction area,
- Compensate cadastral maps and convert coordination by using the reference point,
- Join adjacent cadastral maps and connect the map with a new address,
- Construct spatial DB in the unit of parcel by using UFID, and
- Carry out additional process such as overlapping of digital map and structure map.

The above mentioned UFID refers to the unique number assigned to feature and landform in GIS. Number combination is assigned uniquely to natural and artificial feature such as building, road, river or bridge and the number is used as the geographical identifier of the feature to check and print the location of feature on map and the attributes of the feature for

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administrational division, map sheet and responsible institute. In addition, the number is used as the basic information of LBS(Location Based Service) and plays a role as the connecter with Spatial feature DB.

4.2 Data Format of Parcel Information

Cadastral maps is digitalized in the unit of map sheet and managed in a file form. Thus, the map should be converted into spatial DB has topology when using it in GIS. When the cadastral map is computerized with UFID used in basic geographic information, the map can be connected with SIMC of KCSC so that cadastre information can be updated continuously and quickly. Parcel, the essential part of cadastre information should be in the form of polygon.

This study presents the data model as shown in Figure 4-2, with reference to Korean administrative district system and the standard of basic geographic information established in the past. The feature class contains UFID, attributes and meta data and parcel inherits the features. In addition, Dong or Ri, the smallest unit of administrative district consists of the group of more than one parcel. The land No. and category for each parcel should be entered in the attribute table.
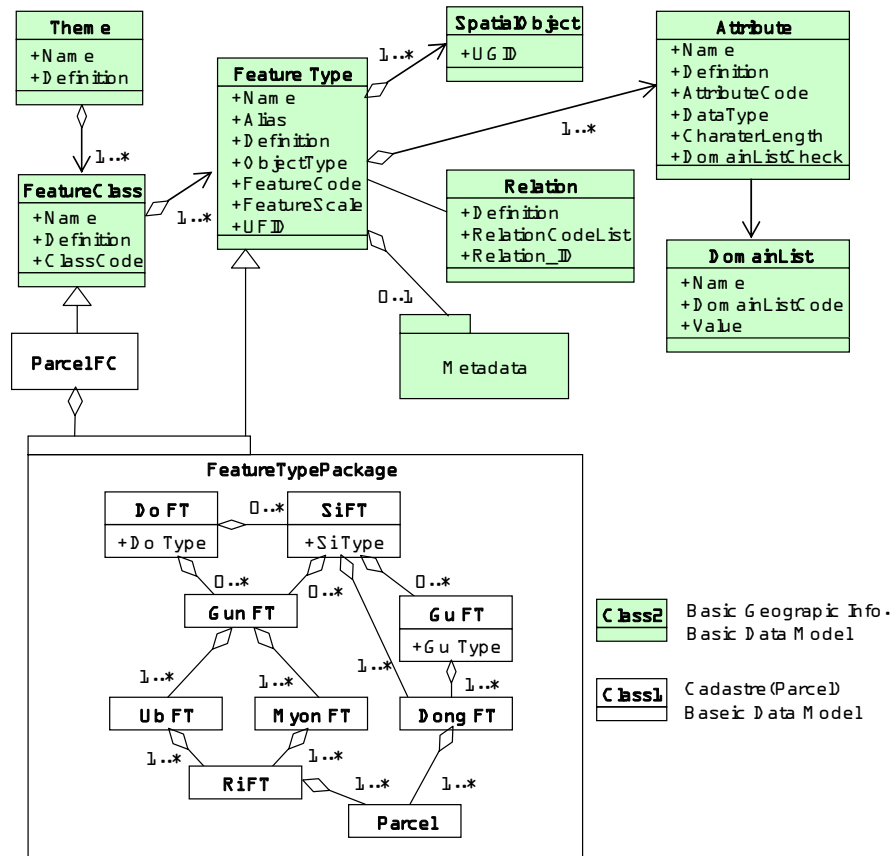
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Figure 4-2: Suggested cadastre(parcel) data model

This study presents the data model for parcel briefly to provide cadastre information to U-City. But, the data model for cadastre reference point and supplementary control point should be built, complying with the standard of basic geographic information, and more study and discussion are needed to establish national standard for the model.

4.3 Type of Information Service

Currently constructed new towns show a marked trend toward U-City to increase the quality of city and its convenience. And, a new town can deploy all infrastructures newly and has the clear limitation on space, all of which provide the most suitable environment for U-City. However, to remove the polarization between old and new town and achieve balanced land development, proactive deployment of U-local information project such as downtown reconstruction project should be carried out. Thus, while the current construction of U-City is focused on a new town, the U-City project is expected to be expanded nationwide in the future. If the project is expanded nationwide, the city unified information center will operate to supervise the whole U-City and KCSC will be able to provide and update the sequential cadastral maps, which is expected to create synergy effect, in combination with land survey project.
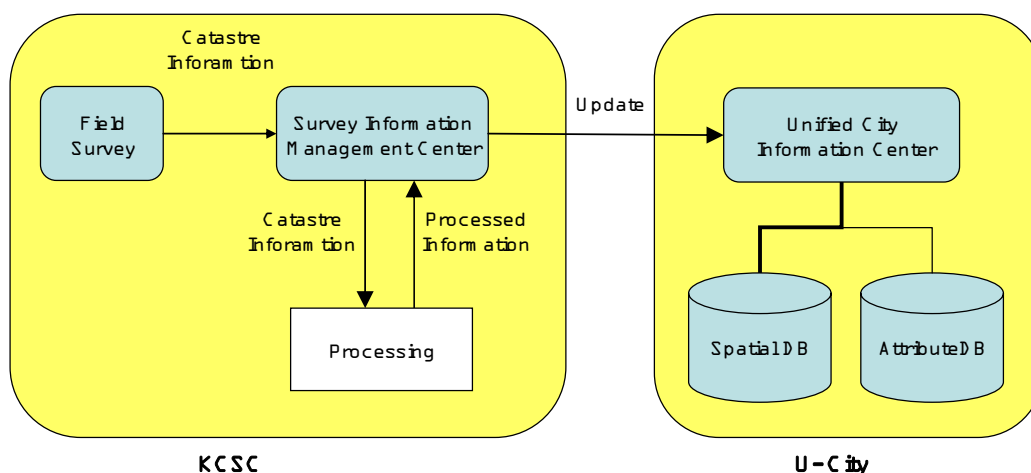

Figure 4-3: Service Method of Cadastre information

KCSC can service the information on parcels on cadastral maps to U-City as shown in Figure 4-3. It is desirable for KCSC to receive data from the municipal that operates U-City, process the data and then, provide them to the city unified information center. The cadastre information needs to be updated when the parcel boundary changes due to division or incorporation or registration information changes due to new registration or erasure. SIMC of KCSC currently under deployment is a management system that accumulates and manages information collected from field survey.

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Therefore, newly added information should be saved in DB of SIMC so that worker can extract the information, convert coordination and assign UFID. Processed information will be reviewed by the municipality operating U-City and then spatial DB is updated in the unified information center. The GIS of the city unified information center can be serviced in various forms via Internet and utilized at kiosks in the public areas or at important points.

5. CONCLUSION

Currently, KCSC does not possess information that can be provided to U-City as the information service. However, in consideration of the expertise accumulated in cadastral survey and nationwide network, KCSC can perform the role of information processor.

The role of KCSC is to compensate cadastral(parcel) information received from municipalities constructing U-City, convert the information into world coordination system, create sequential cadastral maps, connect them with new addresses and carry out additional process such as overlapping of structure map. Because positioning information of various accuracy levels is processed in U-City, the existing compiled map may cause a lot of errors in the space analysis. Thus, the city unified information center supervising U-City will require accurate information in the spatio temporal aspect, and KCSC will continue to update the information even after the construction of the center, in cooperation with SIMC.

Recently, a lot of testbeds are being deployed to test functions and complement defaults before putting the achievement of research in practical use. The plan for process and update of parcel information presented as the result of this study needs also to be tested before putting it to practical use. In this context, since the current U-City depends heavily on IT infrastructure and support of government policy and is limited in space, the U-City provides suitable environment for the test before applying the result of the study nationwide. In addition, because U-City is constructed in a new town, it is relatively easy to collect up-to-date cadastre information and cadastre related information through the confirmed survey and status survey. Therefore, the cadastre related information should be deployed first on the new town that constructs U-City and pilot system should be developed.

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