u-City service Model based on Implementation and Adaptability

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***Abstract*—The realization of u-City is coming near in some local governments by applying various city services, namely, u-City services to the city construction field to improve competitiveness of the city. But it is a reality that some local governments are experiencing many trial and errors in application of the u-City service in addition to the problem posing that the u-City service is not considering characteristics of development or application environment of an individual city.**

The present research proposes a service model for on-site application of the u-City service to solve this problem. The proposed model suggests a method for specifically conceptualizing and objectifying the on-site application that the existing concept-oriented model or an architecture-oriented model, etc. didn't provide. The verification system on effectiveness or effects of the u-City service model to remove ambiguity on the u-City service especially.

The verification system of the u-City service model grasps the technology, function, procedure and target, etc. that the u-City service contains, evaluates whether the model satisfies conditions that the model should have, and secures objectivity and predictability of the u-City service model through confirmation on propriety, implementation and effectiveness, etc.

***Index Terms*—u-City Service, Architecture, Implementation, u-City service Model**

I. INTRODUCTION

Since u-City was proposed in Korea for the first time in 2004, diverse city services based on ubiquitous IT technology, viz. u-City services, are emerging. Also, the demand for promotion of new city development by applying such services to city construction site is rapidly increasing[1]. Such phenomenon is leading to promotion of u-City for which IT technology and city functions are amalgamate in some 40 local governments[2]. Not only local governments of metropolitan regions such as Seoul, Busan and Incheon but also primary local governments such as Paju, Jeonju and Yongin are promoting construction of IT technology amalgamated city by establishing u-City construction plan. Some of them including Paju, Yongin, Busan and Sungnam have already established u-City construction plans and started construction of u-Cities, which will be materialized sooner or later[3].

The purpose of u-City service is to enhance competitiveness of city by utilizing ubiquitous IT technology. The u-City service will enable citizens to enjoy safer and more abundant city lives and will provide companies with business environment of higher competitiveness by enhancing productivity of companies. For materialization of u-City, new concept service, customized for users or intelligent type, needs to be developed and materialized. The number of u-city services being developed or proposed in accordance with such a purpose or goal has already reached some several hundreds[1].

Recently, more intelligent forms of services are also proposed. It is appearance of such services as intelligent space system service or smart object-based service which utilizes new intelligent ubiquitous-based technology[4].

But a problem has been brought up that development or suggestion of such u-City service has not considered the development environment or application environment of cities. For such a reason, plans are inevitably corrected or changed when applying to the site and the original plans are not followed. The criticism is that it lacks the definition as to what technology is required for development of u-City service in detail and what environment is required for materialization of the service developed. Furthermore, study on what merits will be given to the citizens, companies and governmental sectors if such u-City service is materialized is insufficient. In addition, in order to materialize u-City, city lives of new form should be also forecast by combining spatial characteristics of cities and service materialization and application scenario. In fact, in order to materialize a new u-City, change in lives and activities of the beneficiaries of the service should be forecast and spatial change required for materialization of service to be provided should be presented in detail. In addition, appearance of products which shall rely on diverse technology required for u-City service provision should be considered. Here, geographical characteristics of the district where u-City service is provided and whether it has economic efficiency or not are also important considerations.

In this respect, the objective of this study is to grope for a service model to be applied to sites of u-City.

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Though this, we aim to contribute to analysis and development of characteristics of u-City service or to effective and efficient application of proposed u-City service to sites.

II. RELATED STUDIES

The u-City has started being discussed in full scale from 2003 and diverse studies on u-City services have been performed since the u-City forum was established jointly by civil sector and the government in early 2005. In this chapter, we would like to review u-City, concept of u-City service and characteristics of u-City service studied up to now.

A. Concept of u-City

Use of the term u-City started from using it as a strategic concept to differentiate it from existing cities while discussing the plans to resolve diverse problems of cities and to provide abundant city services to citizens. In particular, rapid development of Internet and wireless communication technology have generalized concept of ubiquitous age and the term u-City has been introduced to provide logical ground for application of such concept to various functions of cities such as transportation, environment and education.

The most general concept of u-City is defined as "a city of which various functions are operated and controlled by ubiquitous IT technology"[5]. It is defined as a city of the 21st century which can bring about innovation of various functions of cities such as increase in convenience of city life and enhancement of life quality, safety and welfare of residents through systematic city management and creation of new industry, by amalgamating high-tech IT infrastructure and ubiquitous IT service in the city space[6]. However, the initial concept of u-City was materialization of abundant cities. In order to materialize abundant cities, IT technology was required and, due to this, development of u-City service around IT technology is becoming the main issue.

B. Concept of u-City service

When we consider the definition of u-City we have presented earlier, u-City service can be defined as the functions provided for the members of the cities operated and controlled by ubiquitous IT technology. The u-City service not only resolves problems or adverse effects of functions of existing cities but also enable all the members to benefit by providing the service to all of them. For example, during traffic congestion, the problem can be resolved by inducing dispersion of traffic flow through provision of traffic speed of each road and information about easy road.

The simplest definition of u-City service is u-service provided within a city space[7]. Clear separation between general u-service and u-City service should be done by the fact whether the objects of service are directly related to city functions or not. The u-City service can be classified into u-City service group related to lives of residents which is highly connected to settlement function, u-City group related to industrial activities which is sensitive to industrial characteristics and public service group.

The functions highly connected to settlement functions of cities are those related to transportation, education, public facilities, medical treatment, social welfare, local community, culture, parts, natural environment, city infrastructure, etc. Also, the functions highly related to industrial activities are those related to production, logistics, distribution, research of companies, industrial/school/research network, convention centers, exhibition halls, connection with districts and foreign countries, etc. Public service group includes u-City services related to administrative and public services provided by governmental and public organizations such as administrative organizations[5].

In the examples studied and promoted up to now, almost no analysis has been performed on the detailed difference between the functions of existing cities and city functions provided by u-City service.

C. Classification of u-City service

By systematically reviewing criteria for classification of u-City service, we can use it as basic data when developing a model for application of u-City service to sites. We need to review it in various aspects such as characteristics of technology used for u-City service, how service providers and consumers are related to each other and functional characteristics of cities, etc.

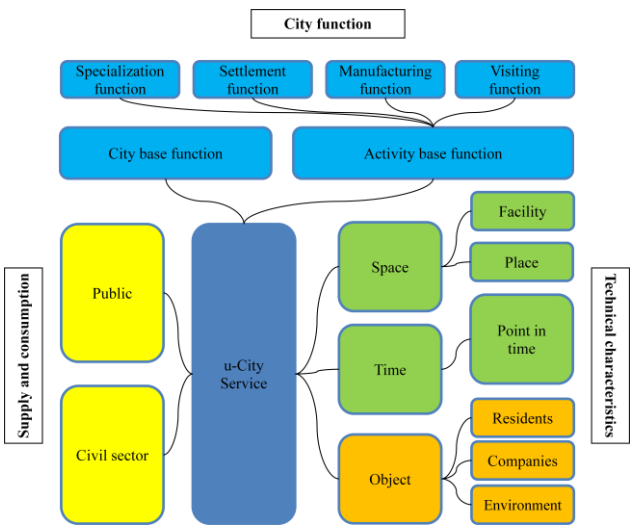

Fig. 1. Classification Aspects of u-City Service

Factors of spatial and time limitations can be overcome using technical characteristics used and u-City services can be classified in accordance with the forms in which the limitations are overcome. The u-City service can be

classified into residents, companies, environment and facility in accordance with the beneficiaries of the service. Also, when we see the service in view of how service providers and consumers are related to each other, service providers can be largely classified into public sector and civil sector. Classifying subjects of service provision can make clear who is responsible for service provision and is helpful in grasping the source for expense required for provision of service. Functional characteristics of cities can be largely divided into city base function, resident settlement function and activity base function which includes company production activity function, and can be further classified into activity base function such as visitor activity function and city specialization function in accordance with necessity[8].

For individual u-City services, we can review each of them in the aspect of characteristics of technology, how service providers and consumers are related to each other and functional characteristics of cities and such an attempt will be helpful in understanding characteristics or nature of u-City service required for construction of u-City and systematizing it.

1) Classification based on objects of service

The u-City service can be classified in accordance with beneficiaries of the service. The beneficiaries of the service can be largely divided into residents, companies and environment and facility of cities.

Residents can be further itemized into students, housewives, the self-employed and workers. Companies can be classified into large companies, medium-sized companies and small companies in accordance with their sizes and may also be classified in accordance with the types of businesses they are running. Residents and companies are subjects of activities in cities. There also is service of which the objects are not residents or companies but is a non-activity subject such as environment. Environment required for activities of residents or companies such as rivers, parks and artificial facilities in cities fall under the category of non-activity subject. The u-City service for non-activity subjects is the service to provide more pleasant environment to subjects of activity in cities such as residents or companies. As to service for non-activity subjects as objects, more improved service will be provided to the subjects of activity being combined or connected with u-City service provided to subjects of activity.

2) Classification based on service providers

The u-City service may be classified into public service and civil service as per who provides the service.

Service providers can be largely divided into government organization such as local governments and public organizations which perform public service on behalf of government organizations and civil sector. Traditionally, city service provided in cities falls under public service. Base facilities such as road, service water and sewage and electricity and public facilities such as schools and post offices are facilities which must be furnished without fail in order to functionally compose cities. Such services related to city facilities fall under public service category of u-City.

All other services of u-City than the public services are civil services. Commercial acts such as sales of products and services, and services related activities of individuals and companies fall under the category of civil service. It is also related to finance, medical treatment and private education.

3) Classification based on city functions

The u-City service can be largely classified into two categories, city base function and activity base function such as resident settlement function and company activity function. The u-City service closely related to base facilities of cities such as road, transportation, crime prevention and service water and sewage fall under city base function. Settlement function is the basic service provided for citizens to lead city life. Parking, medical treatment, education and crime prevention fall under this category. Company activity function is the service required for industrial activities of companies within cities. Finance, tax affairs and distribution fall under this category.

City function may also be divided in political, economical, social, cultural and legal view points. Political function is basically a function of the government and is a function related to public officers and politicians who are connected with decision making of policies. It is closely related to decision makings of cities. Economic function is related to the process of production and consumption in cities. Social and cultural functions are related to arts and religions too.

4) Characteristics of u-City service

The characteristics of u-City service depend on characteristics of technology utilized for the service. Services with 5 characteristics, space problem solving type, possession problem solving type, place problem solving type, procedure improving type and newly creating type, are available in relation to space, time and environment[9][10].

Space problem solving type is a form of service which removes limitation on place and facility through u-City service. It is a form of service which does not have limitation on a specific place as service is not provided around a certain place but is divided into several places. This form of service basically produces effect of expanding the scope benefiting from the service.

Possession problem solving type is a form of service which makes people not to possess facilities such as diverse instruments and devices required for use of u-City service or changes concept of possession. If u-City service is materialized, people can use the related service without possessing specific instrument or device.

Place problem solving type is a form of service made available with no limitation of specific place, which otherwise is available only when the media such as human and human or human and machine should be at a specific place. Such a service basically will greatly increase the chance to provide the service.

Procedure improving type is a form of service made available even when a specific procedure is omitted or changed, which otherwise is available only through a certain procedure. Also, it may be made in the form where new procedure can replace the existing one. Change of procedure is expected to bring about effect of greatly improving service efficiency.

Newly creating type is a form of service which newly creates something that did not exist in the past by introducing ubiquitous technology. It is a typical form of service where new technology creates new service.

In u-City service, above 5 ubiquitous characteristics may individually appear or several service type characteristics may appear complicatedly in combination. For a certain u-City service, diverse types of characteristics can be reflected all together. For example, u-City service can be created to have a combined characteristic of solving limitation in space and having a new service type.

III. U-CITY SERVICE MODEL

The u-City services developed and proposed from 2004 are mostly of the type which converts existing city services into services available anytime anywhere by grafting IT technology onto the existing city services. There have been various attempts to classify such services by applying several characteristics or standards. There also have been attempts to standardize the services because there were diverse types or definitions of each service. In this chapter, we will review general characteristics of each model by studying such attempts around service models.

A. Component model

The most simplified one among the attempts to model u-City service is a model which defines u-City service around its components. Such a model has been widely attempted at the initial period of u-City service. Typical ones are those defined by Han Hohyun[11] and Kim Eunhyung[12]. The characteristic of the model is that things are defined around its components with the focus on technology, objects and functions applied to u-City service. In this model, two services are different if their procedures are different, even though their functions are equally defined. In addition, services are separate too if the city spaces where the services are provided are different. It is because services can be different depending on the space even though they have same function or procedure. Objects of service too should be defined in a same concept. Media for connection of service and subjects which provide u-City service are also needed. Finally, IT technology required for provision of such service should be defined in accordance with the function and procedure of the service.

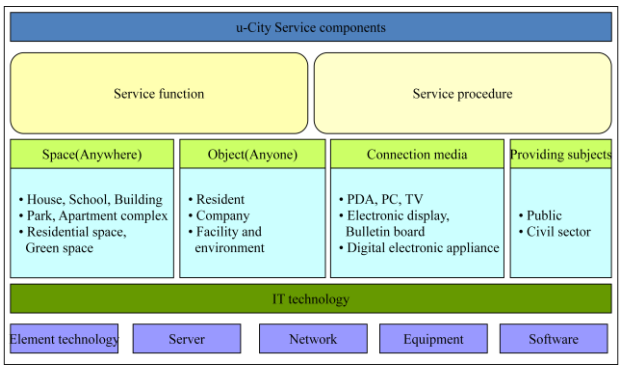

Fig. 2. Components Model of u-City Service

Fig. 2 is the component model of u-City service defined by Han Hohyun[11].

B. Concept of u-City

The model which defines u-City service in terms of its components has a characteristic that consistent definition is difficult as components of a specific u-City service vary. That is because it can be a service of totally different concept depending on what components are emphasized. The concept which emerged to improve such a problem is the architecture model. Architecture model was attempted by Han Hohyun[11] and Lee Sangho[13], etc. and has defined u-City service in terms of conceptualized classes.

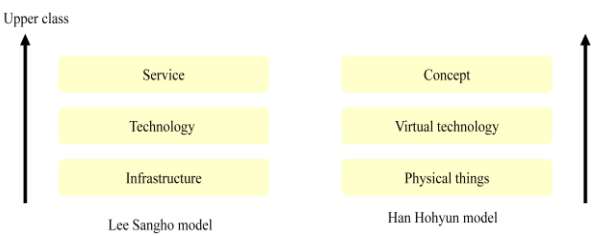

Fig. 3. Architecture Model of u-City Service

Architecture model is an attempt to conceptualize each u-City service. Changeability which is a weak point of component model can be blocked and maintenance of consistency is made possible by defining the service in terms of each conceptualized class. This model could present possibility to assess applicability of u-City service to some extent by enabling separate definition of possibility for materialization and site applicability of each class in detail.

Attempts to define models of u-City service just started being set up. For such a reason, the model is not yet concrete and highly ambiguous. Standard for

objective recognition of u-City service model has not been arranged yet. Also, it is ceaselessly evolving with appearance of new technology and concepts. We need to straighten up service models so that we can more objectively express u-City models, objectively observe appearance of new technology and concepts and have predictability. Especially, we need a model which can predict site application at this stage when construction of u-City is expanding in full scale. For this, in the next chapter, we would like to propose models based on site application and compare and analyze it with the existing models.

IV. SITE APPLICATION BASED MODEL

A. Site application based model

As we have reviewed in the previous chapter, there have been only several attempts to make models required for definition of u-City service. For this reason, much confusion is caused in the sites such as in local governments which try to define u-City service and introduce it. Many attempts are cancelled in the course of introduction or promotion is postponed due to occurrence of unexpected problems. Also, there is concern about waste of time and budget by changing u-City promotion plans several times. It can be defined as ambiguity of u-City service.

In order to remove such ambiguity of u-City service, verification of effectiveness or effect of u-City service is required. Verification of a u-City service model is an act of evaluating whether it is satisfying requirements which a model should be equipped with by grasping technology, function, procedure and objects of the u-City model and securing objectivity and predictability of the u-City service model through checking adequacy, feasibility and effectiveness of the u-City service model. For example, review of technical part can be achieved by examining present technology and future technology required for provision of u-City service. In order to verify effect of u-City service, benefit and advantages provided to beneficiaries should be reviewed and, if the purpose is to earn profit by providing u-City service, the benefit versus investment should be calculated. In this study, we would like to define a site application based model as a model made by reflecting such verification elements on an existing model.

For verification of u-City service model, evaluation shall be done by quantifying it on objective basis through analysis of components of u-City service model. The result of evaluation shall be quantified and utilized as a concept of maturity of u-City service model. Maturity of model is a concept used to relatively compare to what extent a u-City service model is equipped with elements which it should possess with other u-City models, and is not a concept which ensures an absolute value.

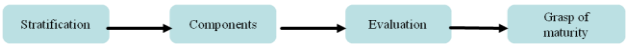

Fig. 4. u-City Service Model Verification Steps

We would say that the most important thing in verifying a u-City model is how to define the u-City model and accomplish classification of its components in an objective aspect. We can say that a u-City service model is a substance of u-City service to be materialized in the future. The characteristic elements of the service we have reviewed earlier become important elements which compose the service. Individual u-City services are defined around the architecture and component models explained previously. Here, verification and evaluation of expense and effect are reflected on each component. In addition, social, cultural and legal/institutional verifications are required. What reflects such result of elements is maturity.

When we review several elements based on this, for the element of service provider and beneficiary, we need to verify the possibility of supply and reception. For space (place and facility), possibility of reception of city space needs to be verified. For service function and procedure, we need to verify whether the procedure of service provision is adequate to achieve the goals of the service. As to IT technology, the main content will be to verify its validity considering the time and level at which each technology can be utilized and the expense required for application. For time, it is required to analyze from what point in time effect appears after the service has been provided. Depending on necessity, review on various elements in social, cultural and legal/institutional aspects may also be required. Also, whether it is connected with adjacent cities or other city spaces can be an important object of verification.

u-City service model is a service to be materialized in future u-Cities. Thus, it has a weak point that verification of the model in the current angle and viewpoint reflecting future situation is difficult. However, the eventual objective of u-City model verification is to minimize errors and unnecessary waste of investment when it is actually applied. In this study, considering such a point, we propose a site application based model of u-City model as follows:

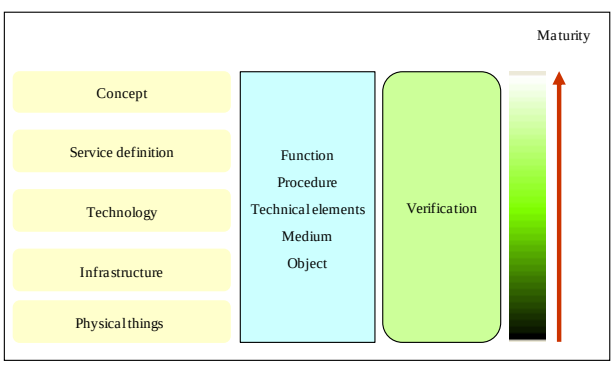

Fig. 5. Site application based u-City Service Model

B. Characteristics of site application based model

Site application based model provides consistency by integrating existing component model and architecture model. Site applicability can be objectively reviewed by reflecting verification elements on it and evaluating and quantifying it. As to verification elements, feasibility of technology, urgency and necessity of consumers and economic efficiency are defined as core elements. On this, verification elements required for validity verification in social, cultural and legal/institutional aspects are reflected. Maturity is measured by digitizing and quantifying such elements.

Maturity is expressed in maturity index. Maturity index is decided by giving weights on verified and quantified figures. Individual verification and weight can be defined and used at each site of u-City. Following table is an example of maturity index measurements.

TABLE I
MEASUREMENT EXAMPLE OF MATURITY INDEX OF SITE APPLICATION BASED MODEL

Verification Element	Verification Aspect	Scale			Weight
		1---------2---------3--------4--------5			
Space	Whether there is service space or not	Insufficient	Adequate	Sufficient	1.5
Objects	Service receiving condition	Insufficient	Adequate	Sufficient	2.5
Time	Long/short-term effect	5 years	3 years	1 year	1
Provider	Providing condition of providers	Insufficient	Adequate	Sufficient	2
Function	Clarity of function	Ambiguous		Clear	1.5
Procedure	Clarity of procedure	Unclear		Improved	2.5
Technology	Feasibility of technology	Ambiguous		Clear	1.5
Expense	Adequacy of expense	High		Low	1
Effect	Effect	Ambiguous		Clear	1.5
System, Culture	Cultural receiving condition	High		Low	2
Connectivity	Possibility of service in connection	Exists		Low	1

Site application based model has following features in comparison with existing component model and architecture model:

- It is a class-based model which can be standardized.
- The elements which compose u-City service can be conceptualized and defined. When needed, ambiguity can be prevented by evaluating conceptualized elements.
- When importing u-City service, objective evaluation can be achieved through measurement of maturity, etc.
- Problems which can occur when applying it to the site can be prevented by securing feasibility and predictability.

V. CONCLUSIONS

Since u-City is proposed in Korea for the first time in the world, diverse city services, viz. u-City services, are emerging. Also, some of local governments have already promoted construction of new cities by applying such service to city construction sites and their u-Cities will be materialized sooner or later.

The eventual goal of u-City service is to enhance competitiveness of cities. In addition, it is to enable citizens to lead safer and more abundant city life and provide companies with highly competitive business environment by enhancing their productivity.

But, in reality, we are experiencing many trials and errors in applying such u-City service. It was pointed out that the development environment and application environment of cities were not taken into account. Correction and modification inevitably take place when applying to the sites and introductions are not promoted as initially planned. Furthermore, there are examples of service implementation being stopped after materialization of such u-City service because of operation cost, etc.

In this respect, this study has proposed a model for application of u-City service to sites. The proposed model is a model to apply u-City service to sites. We have proposed a plan to systematically conceptualize and objectify site applicability which existing concept-centric model or architecture-centric model has not been able to provide.

In particular, in order to remove ambiguity of u-City service, a system to verify effectiveness and effect of u-City service model has been reflected on the model. The verification system of u-City service model has been defined to be an act of evaluating whether it is satisfying requirements which a model should be equipped with by grasping technology, function, procedure and objects of the u-City model and securing objectivity and predictability of the u-City service model through checking adequacy, feasibility and effectiveness of the u-City service model.

We expect site application based u-City model to become a useful means to select and evaluate u-City models which are to be applied at sites. Systematic future studies on evaluation and verification methods for the proposed model seem to be needed.

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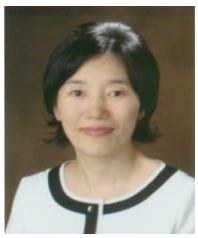

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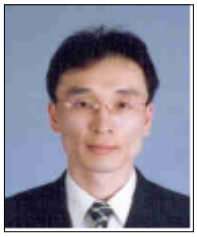

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