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Beacon's Visible Information Structure and System Design for Tourism Content Service

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Abstract

In the case of LBS(Location Based Service) systems using beacons, which have received a lot of attention recently, they recognize information about the user's location as well as UUID, Major, and Minor of beacons through BLE(Bluetooth Law Energy) communication between the user's device and beacon and then, provide the user with the contents matched the user-UUID-Major-Minor information, and beacons are only used to dissipate signals of certain frequencies. Therefore, there have been major interests in the development of solution technologies to provide users with the aforementioned service by integrating with other information systems through the use of such signals.

In order to provide a user with LBS(Location Based Service), it is necessary to have proper and efficient technologies to install and control beacons. They should be considered as technologies to be developed beforehand. As the no. of beacon services increases, the importance of beacon H/W management is also increased, and it becomes necessary to have a proper way to distinguish beacons in the beacon dense area.

In this study, for examining the visible information structure and system design of beacons, it aims at addressing the previous system design using beacons, designing the visible Beacon UUID-Major-Minor Structure for provision of tourism content services, and designing the system for storing and analyzing data arising out of services using beacons

Keywords: *UUID, Major, Minor, RSSI, Location Based Service..*

1. INTRODUCTION

In the case of LBS(Location Based Service) systems using beacons, which have received a lot of attention recently, they recognize information about the user's location as well as UUID, Major, and Minor of beacons through BLE(Bluetooth Law Energy) communication between the user's device and beacon and then, provide the user with the contents matched the user-UUID-Major-Minor information, and beacons are only used to dissipate signals of certain frequencies. Therefore, there have been major interests in the development of solution technologies to provide users with the aforementioned service by integrating with other information systems through the use of such signals[1][2]. Once beacons are installed, they have little changes in location or information due to the nature of its system design, it is necessary to have a clear design rule.

This study suggests the UUID-Major-Minor structure, an information for distinguishing beacons, installed in offline tourist attractions, for visible classification and efficient management of the beacons, and generalizes the system design structures of the existing beacon solutions. In order to provide a user with LBS(Location Based Service), it is necessary to have proper and efficient technologies to install and control beacons. They should be considered as technologies to be developed beforehand[3][4]. As the no. of beacon services increases, the importance of beacon H/W management is also increased, and it becomes necessary to have a proper way to distinguish beacons in the beacon dense area[5]. In the case of Front-End development, it has gone through significant changes in its ecosystem so as to be called 'web application development' in the web page. Among them, the advent of node.js became the cornerstone of various ecosystem changes, many services are currently working on the development of services using the node.js ecosystem.

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Front-End development using Node.js refers to a single page application(spa) type web development and it is made with technologies such as jsx and redux along with react developed by Facebook, in consideration of SSR(service side rendering). On the other hand, in the case of back-end development, major websites including Netflix, Amazon, and Ebay, have shifted from monolithic architectures to microservice architectures. To realize microservice architectures, various matters, including the concept, implementation method, troubleshooting, security, log collection, distribution, and period of application, must be considered[6].

Monolithic architecture is an opposite concept to Micro Architecture, and it exists in the structure of a single-application container, and a number of components are strongly combined into one structure. Although it has an advantage of having an unified structure, it has a significant disadvantage that entire applications must be corrected and distributed to correct a single module, taking a lot of time for the server start-up and build deployment**[7].** On the other hand, MicroService Architecture (MSA) refers to a method of developing an application by combining small services. It breaks up components of an application, makes them each an independent application, and combine these independent applications through API to create one large application. The advantage of MSA is that it could get away from the centralized management, and since each service is developed under independent business logics and different programming languages and environments, it could overcome the disadvantage of Monolithic Architecture, which is the entire correction and distribution. In addition, it is easy to change or expand the service, it is possible to effectively apply the big data analysis platform in the rapidly changing environment. Of course, it has several disadvantages as well, including a difficulty in identifying the status of services due to the expansion of the scale of the project, a difficulty in debugging, and an increase in various overheads. However, MSA is the only architecture that could reflect the rapid changes in the big data analysis ecosystem[8].

Therefore, this study suggests UUID-Major-Minor structure, an information for distinguishing beacons, installed in offline tourist attractions, for visible classification and efficient management of the beacons, and designs and suggests the big data analysis platform using the history of beacon use and telecommunication company data, reflecting the recent development trend.

2.URELATED RESERCH

As for recently developed technologies for indoor positioning, there is a BLE(Bluetooth Low Energy)-based beacon. This technology can detect the position of a device with lower power and is currently receiving a lot of attention [9].

Beacons are a Bluetooth-based short-range communication service technology. Once a user enters its range, a beacon application on a mobile device of the user detects a signal and positions a user and then, transmits a certain information[10]. With the rapid dissemination and consistent improvement of smart devices, a wide variety of services using smartphones have been offered. Especially, the LBS(location-based service) market relies heavily on GPS information. However, GPS services have a difficulty of indoor positioning and GPS devices are relatively expensive, the scope of Beacons has been expanded[11].

For services to be provided to users, it is critical to have a technology that can determine or identify the location of a user. Recently, various positioning technologies have been tried as shown in Table 1. In the case of smart device-based positioning technologies, they include BLE Beacon, NFC, WI-FI, Sound Beacon, and Geo-fencing[12].

Table 1 : Utilize available technology to compare the user positioning

	BLE	NFC	Wi-fi	Geo-fencing
Contact method/ Distance	Non-contact/ up to 50m	contact/up to 0.1m	Non-contact/up to 100m	Non-contact/ 100m or more
Frequency	2.4~2.5GhZ	13.56Mhz	2.4Ghz	-
Availability	Android : 4.3 or more iOS : 6 or more	Android : 2.3 or more iOS : Non	Android : Support iOS : Support	-
Automation Invoke	Support (iOS7 or more)	Support	Non-Support	iOS 4.3 or More

The following is a brief overview of indoor, outdoor, and any other positioning technologies.

1) For LBS outdoor positioning technologies, there are GPS, SBAS, LPWA, and RTK. GPS, using GPS satellites, is the most common and popular positioning technology, but its accuracy is relatively poor. In order to supplement such weakness, SBAS and RTK have been developed and used,

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and with the propagation of IoT environments, Low-Power Wide Area (LPWA : a positioning technology using low power broadband communication) has been widely used as well[12].

2) For LBS indoor positioning technologies, there are Wi-Fi, BLE Beacon, UWB, and Geo-Magnetic. Recently, positioning technologies using cameras and inertial sensors have been developed. Each technology has different accuracy, weakness, and strength, so they are used for various areas according to the intention and purpose of positioning[12].

3. RESULTS AND DISCUSSIONS

In this study, for designing of the visible information structure and system of beacons to provide tourism contents services, it mapped DB information onto IDs of UUID-Major-Minor and then, compared the suggested visible UUID-Major-Minor information structure. For the next, it suggested a direction for design of a system to provide tourism contents services on the big data platform in the efficient manner.

A. Beacon

[Fig. 1] shows a typical data set that can be stored in beacons. In general, it has the structure of 9 – 16 – 2 – 2 - 1 byte for prefix – UUID – Major – minor – power. In this study, visible information of beacons was designed using the UUID – major – minor(16 – 2 – 2), excluding the domains of 9 byte occupied by prefix and 1 byte managed by measured power.

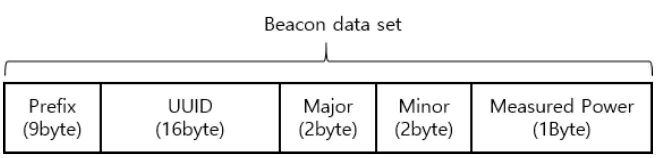

Figure 1 : Beacon Data Set

[Fig. 2] represents the UUID-major-minor structure suggested by this study, showing the 16Byte-32digit domain occupied by UUID. The UUID domain is constructed with 8 digits of Beacon default, containing the basic identification information of the beacon; 4 digits of integers of the latitude at which the beacon is installed; 6 digits of decimals of the latitude at which the beacon is installed; 4 digits of whole integers of the longitude at which the beacon is installed; 6 digits of decimals of the latitude at which the beacon is installed; and 4 spare digits for additional information of the beacon.

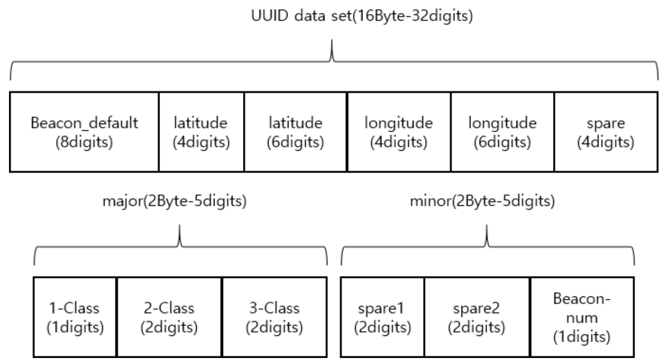

Figure 2 : UUID-Major-Minor

In the case of the Major domain, it is where visible information of the beacon is stored, so information to be stored is classified by 1-class for 1 digit, 2 class for 2 digits, and 3 class for 2 digits.

In the case of the Minor domain, it is where visible information that cannot be classified as Major becomes classified and then, stored. It is classified by spare 1 for 2 digits, spare 2 for 2 digits, and beacon number for 1 digit.

B. UUID-major-minor

[Table 2], [Table 3], and [Table 4] express the data structure to be stored in the suggested UUID-Major-Minor structure. If it is used to express a cultural heritage site located at 19, Gwandeok-ro, in Samdo 2-dong, Jeju City, as shown in Table 1, it could be expressed as 00000000-0033 -513345-0126-521532-0000.

Table 2 : UUID Design

uuid(8-4-4-4-12)16Byte					
beacon_default (8digits)	latitude		longitude		spare (4digits)
	latitude (4digits)	latitude (6digits)	longitude (4digits)	longitude (6digits)	

By having 00000000(8 digits) as the default value of the beacon, it can be used as the factory identification value, and 0033-513345(4 digits-6 digits) is to express the latitude of 33.513345, and 0126-521532(4 digits-6 digits) is to express the longitude of 126.521532, and 0000(4 digits) is to express additional information with 4 digits.

[Table 3] shows the classification of tour information using the major and given with the classification code accordingly, the Gwandukjeong located at 19, Gwandeok-ro, in Samdo

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2-dong, Jeju City can be expressed as 1-02-08. 1(1 digit) expresses the name of city, district, and area of that site, 02(2 digits) expresses that Gwandukjeong is a cultural heritage site, and 08(2 digits) shows that the Gwandukjeong is classified as a cultural property.

Table 3 : Major Design

major(0~65535)2Byte					
1-class (1digits)		2-class (2digits)		3-class (2digits)	
index	value	index	value	index	value
0	none	00	none	00	none
1	jeju	01	nature	01	rise
2	seogwipo	02	culture-T	02	beach
3	eastern	03	theme-T	03	cave
4	western	04	w-tour	04	waterfall
		05	leisure	05	valley
		06	island	06	forest
		07	festival	07	arboretum
		08	shopping	08	cultural heritag
		09	accommo	09	gallery
		10	food	10	exhibiton
				11	concert hall
				12	theme park
				13	museum
				14	jeju olle
				15	geology
				16	golf
				17	hunting
				18	marin sports
				19	riding
				20	ATV/cart
				21	paragliding
				22	camping
				23	experience
				24	island
				25	festival
				26	event
				27	specialties
				28	duty free shop
				29	tradi market
				30	shop
				31	flea market
				32	hotel
				33	resort
				34	motel
				35	pension
				36	guest house
				37	local food
				38	korean food
				39	western food
				40	japansese food
				41	chinese food
				42	asian food
				43	café

Table 4 : Minor Design

minor(0~65535)2Byte					
spare1 (2digits)		spare2 (2digits)		Beacon-num (1digits)	
index	value	index	value	index	value

[Table 4] is a domain for distinguishing the beacons, installed in multiple numbers at a certain location, using the value of minor, and if more than one beacons are installed at the Gwandukjeong, expressed in the domains of UUID and Major, they could be expressed as 00-00-1, 00-00-2, and so on. 00-00(4 digits) is the domain for detailed distinguishing of beacons, and 1(1 digit) is the domain for expressing the number of beacons. If there are 9 beacons or more in the same space and they have to be distinguished, they could be distinguished using spare 1 and spare.

C. Hive, Hbase with HDFS

[Fig.3] shows the big data platform that can collect big data arising from beacons and user services, first suggested by the study. It represents the Hadoop Ecosystem[13]. The file system allows the distributed processing and storage using HDFS, uses Hbase architecture, and supports wide Column, so it could support the efficient DB storage and access. In addition, it also could raise the quarry processing speed through the uses of JOB scheduling, data application, and Hive by using MapReduce. In addition, by using Pig, it could provide the optimization of performances not provided by MapReduce, or function expandability. In order to connect and configure HDFS and other relation-type DBs, Avros is deployed to serialize data in Sqoop or Json compact binary formats, and distributed configuration of every node and synchronization services are controlled through ZooKeeper[14][15][16].

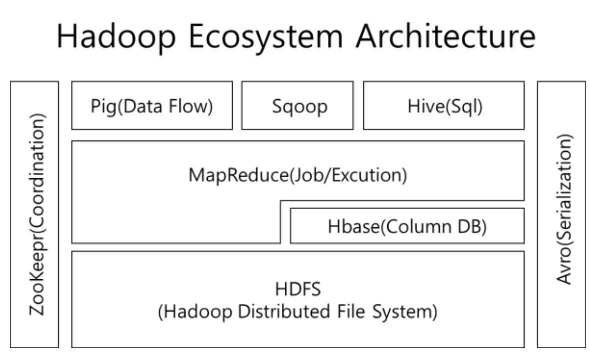

Figure 3 : Hadoop Ecosystem Architecture

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D.Elastick Stack

[Fig. 4] is the system architecture using Elastic Stack, the second big data platform suggested by this study [17]. In the case of Elastick Search, it is an open source analysis engine that can search using Lucene-based FullText and operates in REST API. On the other hand, Logstash uses various PLUG-INs to aggregate and store beacons and user data and then, filter them through the data processing, pipeline data collection, and filters, and send to Elastick Search. In the case of Kibana, it is configured for data visualization of data for the Elastick Search Engine. In addition, by using Beats along with Logstash, it could be extended for collecting data, such as Packet, File, Monitoring, and Event Log.

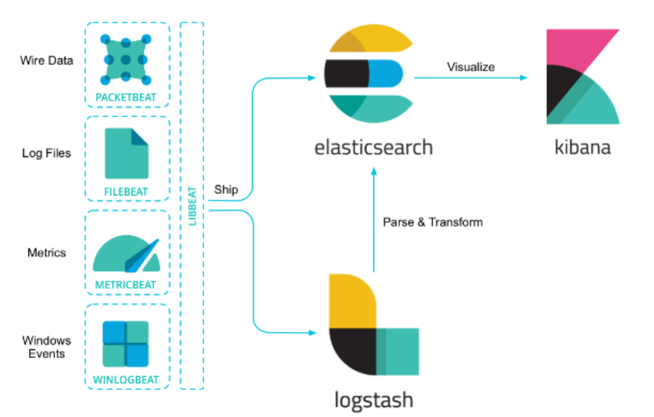

Figure 4 : Full Elastic Stack

[Fig. 5] is a hybrid big data platform using Full Elastick Stack. Hadoop Ecosystem and Elastick Stack use X-pack to communicate, and by using messaging cue services, such as Kafka, between light weighted Beats and Logstash, it can communicate.

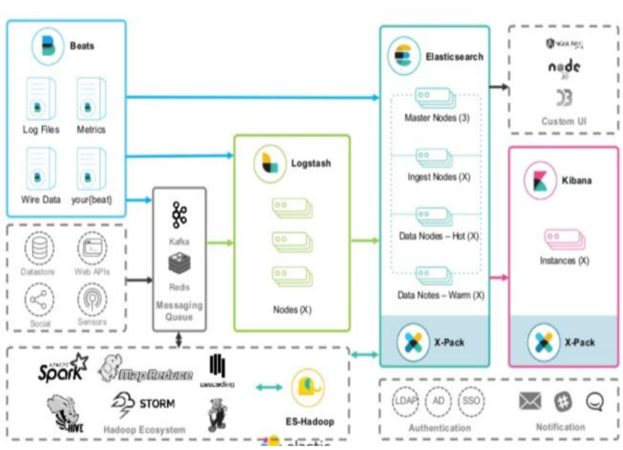

Figure 5 : Elastick Stack With Hadoop Ecosystem

E. User System

[Fig. 6] expresses the domain of user web services performed on the big data platform of Hadoop Ecosystem or Elastick Stack. In the case of the Back-End, it prefers the services that separate node.js-based user history and beacon history that are compatible with the big data platform and then, rest[18]. On the other hand, in the case of Front-End, React and React-Strap, which are popular SPA-based web development methodologies, Redux for SPA status check-up, and Big Data visualization are configured based on D3.js, and it has been designed to go beyond the scope of the existing Monolithic web development methodology by using a service medium called graphQL and to be able to expanded for the continuously changing big data ecosystem and environment [19-21].

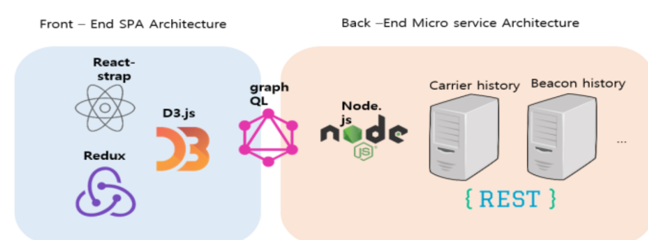

Figure 6 : Web - Service - Architecture

4. CONCLUSION

In this study, it has suggested the system design using the existing beacons for visible information structure and system design of beacons for providing tour content services. In addition, it has designed the visible Beacon UUID-Major-Minor structure for providing tour content services, as well as the system that can store and analyze data arising from the provision of services using beacons. For the big data system architecture, it has suggested two architectures using Hadoop ecosystem and Elastic Stack, respectively and a hybrid architecture combining these two architectures, and for the final user service format, it has suggested the Front-End SPA architecture based on Back-End Micro Service Architecture, and using React-strap and D3.js. Based on the big data architecture, SPA and Micro Service architecture using visible beacon identification data, Hadoop ecosystem, and Elastick Stack, it is possible to provide tour contents in the efficient manner and to expand to cope with the consistently changing big data ecosystem and environment, but it requires feedbacks about the actual implementation, development, and tests of the entire architecture.

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