Platform for Location-Based Services

● Kyohei Tamai ● Akio Shinagawa

Fujitsu is creating new values and services by gathering massive amounts of data generated in actual societies, and analyzing them with information and communications technology (ICT). We have constructed a platform for location-based services in a cloud computing environment. It solves a wide range of location-based problems, as typified by traffic congestion, by using positional information collected through the Global Positioning System (GPS). As the first version, we have started providing services of a function to generate floating-car-data-based traffic information, a function to conduct Point Of Interest (POI) searches and an optimum path finding function. We will provide the following services which include a function to utilize massive quantities of collected data controlled by the platform for location-based services. It can be used in various ways. For example, it can be used as an application component, as an application platform utilization service, and as an application platform accessed from systems constructed for users inside the platform for location-based services. In the years ahead, we plan to expand its content, services and functions, and create some additional value by diversifying its data collection fields.

1. Introduction

To achieve Human-Centric Intelligent Society, Fujitsu is creating new values and services by gathering massive amounts of data generated in various fields including traffic, medical care, energy, agriculture and urban development, and analyzing them with information and communications technology (ICT). The establishment and expansion of these as a new business domain is Fujitsu's purpose of business.

In the course of these activities, we have first focused our attention on positional information collected through the Global Positioning System (GPS) and so forth. To solve a wide range of location-based problems as typified by traffic congestion, we have constructed a service platform to make use of location-based information (hereafter "platform for location-based services") in a cloud computing (hereafter "cloud") environment.

This paper first outlines the platform for location-based services and presents the functions operating on the platform, followed by forms of using the platform. Then, the effects of using cloud as an embodiment of these services and a future vision of them are explained.

2. Outline of platform for location-based services

The platform for location-based services is intended for gathering, organizing, analyzing and making use of real-time information,[note 1)] facility information, Web text information, and such like accompanied by positional information in various fields. Pieces of information that have not been

note 1) Includes information about the surrounding environment and state of mobile objects. Can be collected in real time by using sensor devices.

mutually associated, and so handled separately are associated with locations in real space to treat them in a unified manner. This creates new added value based on cross references and complementary relationships and allows new content and services to be realized.

On the platform for location-based services, content and services generated from massive amounts of data are provided through internal applications. At the same time, the platform of the applications is also available. The application platform is intended for processing the massive amounts of data gathered and allows users to analyze and use the massive amounts of data based on their intention. At present, users of the application platform are businesses that make use of massive amounts of data to provide services. For many businesses, handling massive amounts of data requires a large-scale system and technology to manage it, and this has posed many challenges in terms of cost and technology. Gathering these diverse pieces of information has also been a difficult issue to resolve. Using this application platform solves these problems and allows new services to be realized easily.

The platform for location-based services consists of an application unit and application platform unit, as well as a cloud environment and network platform that support them (**Figure 1**). The following subsection describes the configuration of the platform for location-based services.

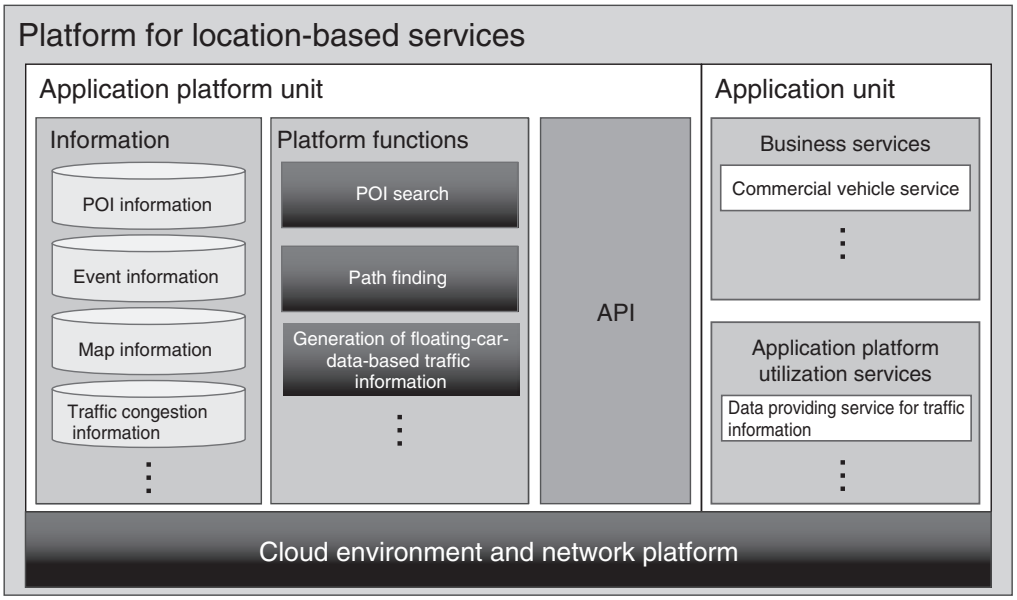
2.1 Configuration

1) Application unit

The application unit is composed of business services and application platform utilization services. Applications for the purpose of end users' direct use such as commercial vehicle operation management applications are prepared for business services. In addition, applications for making use of the application platform are prepared for the application platform utilization services.

2) Application platform unit

The application platform unit is composed of application programming interfaces (APIs), platform functions and information. APIs are



POI: Point Of Interest
API: Application programming interface

Figure 1
Configuration of platform for location-based services.

interfaces for using the functions and various types of content in the application platform unit. The platform functions are a group of functions for generating content and developing different services. The information stored includes information gathered on the platform for location-based services and content generated.

3) Cloud environment and network platform

The cloud environment and network platform is an IaaS platform provided by Fujitsu Global Cloud Platform "FGCP/S5"[1), note 2)] service. The components of the application and application platform units are built on the IaaS platform, and this allows costs and time taken for creation to be reduced as compared with building in the existing environment.

As a characteristic of cloud, the computer resources used can be reduced according to changes in the load. Cloud allows operation at lower costs than existing centers, for which fixed amounts of computer resources are prepared for the peak load. The reduction in operational costs is passed on to users as well in the form of lower offering prices. In addition, regardless of whether it can be anticipated, a large quantity of computer resources can be made available in a relatively short wait time and massive data processing can be readily realized.

The following subsection presents major platform functions.

2.2 Platform functions

1) Function to generate floating-car-traffic-data-based traffic information

The function to generate floating-car-traffic-data-based traffic information generates traffic information indicating the degree of congestion of the respective road sections[note 3)]. This is based on the location information (changes) of a large number of floating cars distributed in a wide area. A floating car is a vehicle equipped with a GPS and a function to wirelessly send the positioning data of its location to the center (platform for location-based services). The positioning data of floating cars (floating car data)[note 4)] are gathered to find the average drive times for the respective road sections in real time, which are used as floating car traffic data. To generate high-quality traffic information, Fujitsu mainly uses taxis as floating cars. Floating car traffic data cover non-arterial roads as well and are capable of complementing traffic information based on vehicle drive speed measured by the infrastructure (**Figure 2**).

The floating car traffic data generated are offered to customers as one piece of content. In addition, Fujitsu is considering generating forecast traffic information based on the accumulated traffic information.

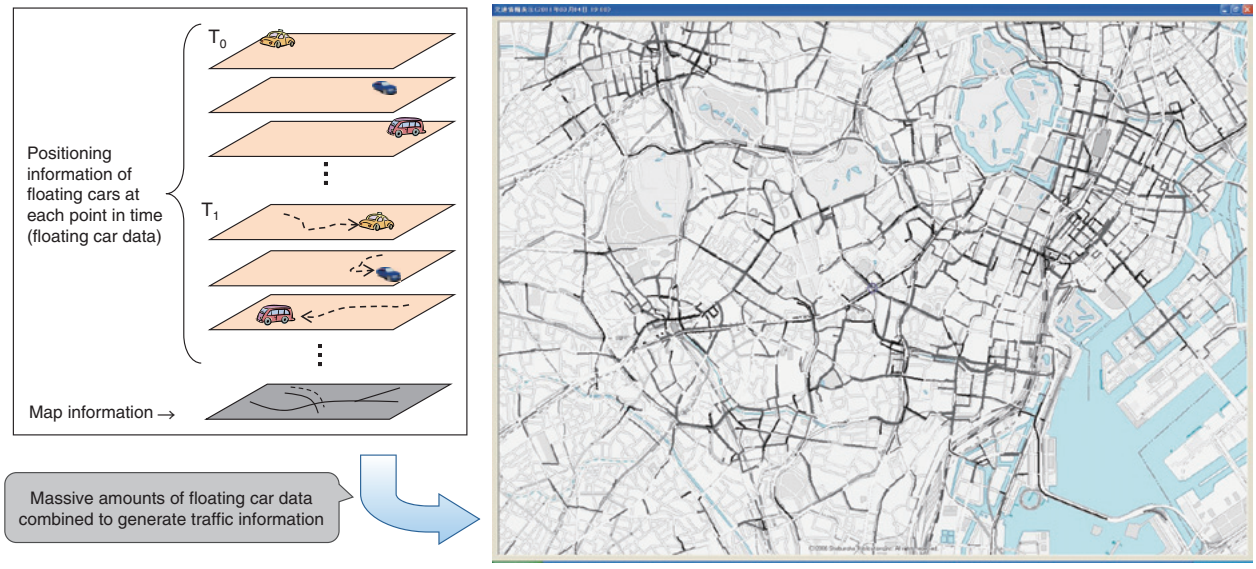
2) POI search function

The Point Of Interest (POI) search function is basically a platform function to manage massive amounts of data such as facilities scattered on a map and search for them. The massive amounts of data used include not only those prepared by Fujitsu but also data owned by specialized businesses. This function is used, for example, for specifying a certain facility as the destination for path finding. For this function, the flexibility of POI search is improved by incorporating information associated with locations widely gathered. Conventionally, it was not possible to conduct facility searches without accurately specifying addresses or telephone numbers. With this function, however, widely-known common names or somewhat inaccurate names can be used for searches. Searches for facilities by the names of events held there or

note 2) It was named as Global Cloud Platform (GCP) in overseas markets.

note 3) A part of a road between intersections or division(s) of the part is treated as one section. Road sections of different traffic directions (inbound and outbound) are treated separately.

note 4) Data gathered from floating cars are generally referred to as "floating car data" and these are not limited to only positioning data.



(Map Usage Approval © Shobunsha Publishing #53G028)

Figure 2
Function to generate floating-car-traffic-data-based traffic information.

for representative points in event venues by the event names are also possible. Furthermore, searches by narrowing down the facilities concerned based on the areas and facility types, and by using outlines that people have common mental images of (Ginza, for example), rather than administrative boundaries of areas, are available as well.

At present, searches by making use of "hot place to visit" information generated by analyzing Web text information including microblogging information are under consideration.

3) Path finding function

The path finding function of the platform for location-based services is intended for path finding in view of traffic conditions that change from hour to hour. It can search for paths that allow travel from the origins (departure places) to the destinations in the shortest time. Conventionally, traffic congestion information was unavailable or, even if available, the area of information provision was limited. In such cases, the effect of the traffic congestion existing in reality but not known was often significant, resulting in paths given that required more travel time than necessary. With this function, however, detailed floating car data that cover a wide area are available and minimum travel time paths to the destinations can be more accurately provided (**Figure 3**). Path finding is available nationwide and, for areas in which real-time traffic information is provided, path finding in view of the information is possible.

Floating car traffic data, which cover non-arterial roads as well, contain a large volume and are difficult to be supplied to navigation terminals and such like in real time. For that reason, the path finding function is prepared in the center.

3. Function for making effective use of massive amounts of data

The platform for location-based services has different uses and offers different values depending on the user because information gathered can be in a wide range of fields and its content can be diverse. Accordingly, the platform is equipped with a function for making effective use of information to choose what is required out of the massive amounts of data gathered and to put it to use. This function is provided in the

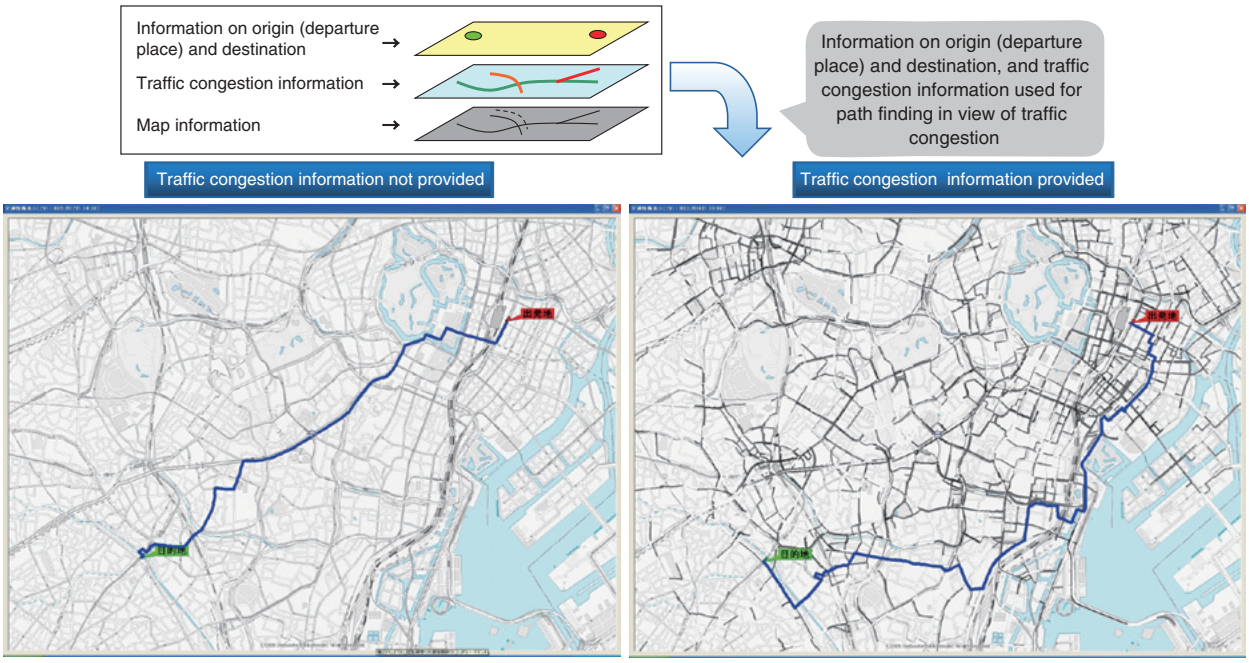


Figure 3
Path finding function.

application platform and used when the platform is used.

The function is intended to generate a kind of virtual space, in which the information gathered and content generated are associated with locations and arranged. Information gathered by users themselves can also be arranged in a kind of virtual space. Users can refer to or process the generated information in a kind of virtual space by means of platform functions of the application platform or original processing programs, thereby creating content or services.

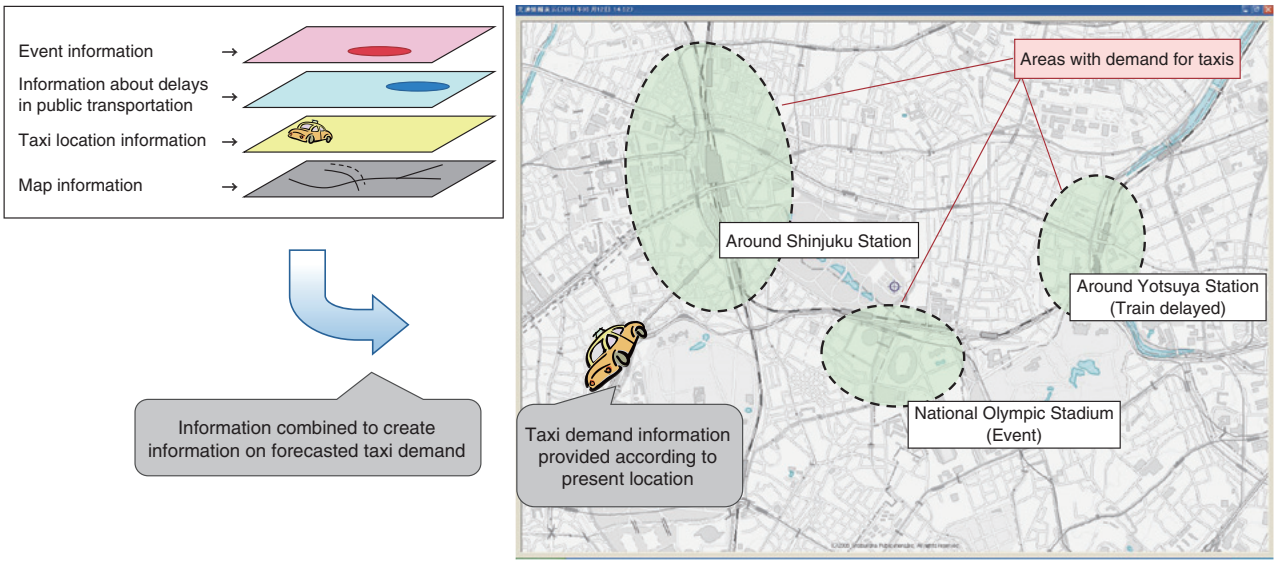
Possible examples of using this function include generating and providing demand forecast information for taxi businesses. A taxi business chooses the types of information used for demand forecast (event information, information about delays in public transportation, etc.) and generates a kind of virtual space. The state of the space is analyzed with an original processing program that comprehensively evaluates the effect of the respective types of information on the demand for taxis to generate the territory-specific demand forecast information. The demand forecast information generated is then provided to taxis driving in the territory. While different areas have different factors that influence the demand for taxis, businesses can appropriately combine different types of information for their own areas, and accurate demand forecast information can be generated and provided. Other possibilities include acquisition of the present location information of taxis to map them in the space for providing information when they drive in high-demand areas (**Figure 4**). Furthermore, there is a possibility of combining this information with the path finding function to give guidance to the area concerned.

4. Forms of use of platform for location-based services

Forms of use of the platform for location-based services can be roughly classified into the following three categories (**Figure 5**):

1) Use of business services

Applications for business services are used from outside the cloud for using the services



(Map Usage Approval © Shobunsha Publishing #53G028)

Figure 4
Example of service using function to deal with massive amounts of data.

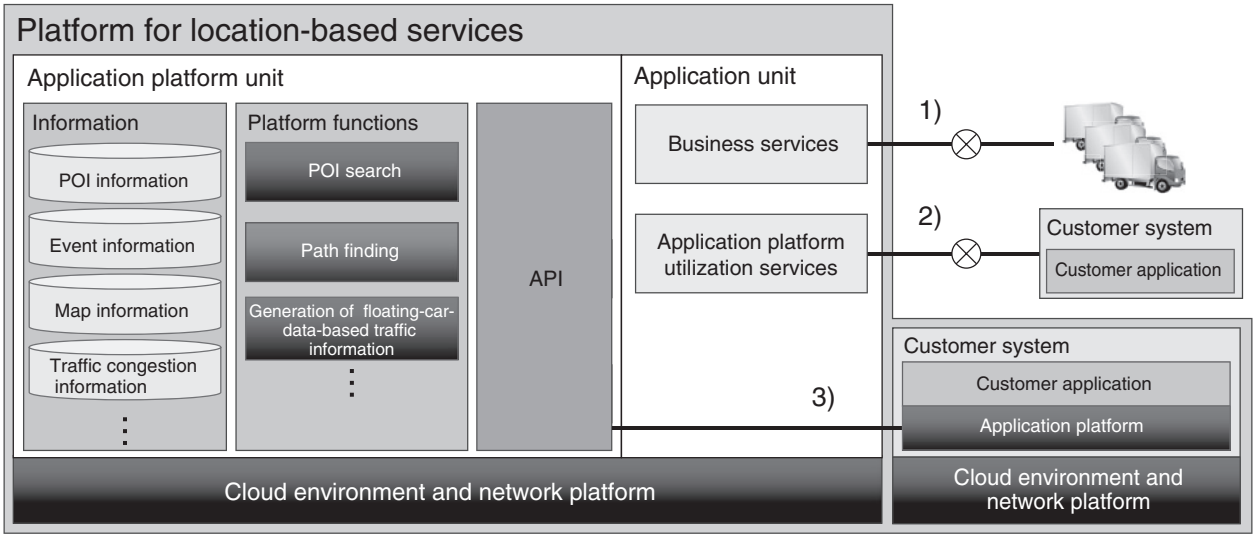


Figure 5
Forms of use of platform for location-based services.

provided. The services can be directly used from terminals of in-vehicle equipment and such like.

2) Use of application platform utilization services

The application platform utilization services are used from outside the cloud. Users can make use of the functions of the platform for location-based services from applications of their own systems through these services.

3) Use of application platform by building user system on platform for location-based services

The information in the platform for location-based services and the platform functions are used in users' own systems in the cloud. Users can complete processing within the cloud, which ensures high security and allows them to use highly confidential information.

In this form of use, the system is built on the IaaS platform provided by Fujitsu Global Cloud Platform "FGCP/S5" service and its benefits can be enjoyed as well.[1)]

5. Effect of constructing platform in cloud environment

Because the platform for location-based services is built on a cloud, computer resources can be added or reduced according to load changes and cost per unit process can be reduced, as described earlier.

"Industry-University Collaborative Software Engineering Practice Project 2009" was a project commissioned by the Ministry of Economy, Trade and Industry (METI). In it, Fujitsu constructed on a cloud a floating-car-traffic-data-generation function, and a request-response application that uses the data. For both cases (this function and this application), Fujitsu studied the degree to which costs can be reduced by using the cloud. Concerning floating car traffic data generation, the amount of floating car data handled may significantly vary depending on the time of day, and the maximum amount of one day (at midnight) can be about twice as much as the minimum amount (in the early morning). When that happens, a large difference is caused in the load of generation of floating car traffic data between midnight and early morning. With the request-response application, the request frequency may also significantly change according to the time of day and the processing load varies to a considerable extent. Accordingly, the resource amount for use was optimized by operating many computers (virtual machines) at the maximum load and a small number of computers at the minimum load in both cases. The result is that, in a trial calculation (comparison) where an ordinary computer is assumed as the reference, use of the cloud has been proven to be able to reduce the computer resource amount by about 30% in both cases.[2)]

With systems that gather, process and provide massive amounts of data such as the platform for location-based services, the processing load often varies significantly depending on the time of day. For that reason, the cost reduction effect by the optimization of computer resource amount is expected to be higher than with ordinary systems.

6. Future vision

In the future, along with the advance of sensor and network technologies, the types and amounts of collectible real-time information are expected to increase remarkably. We intend to make use of such information in the future to enhance the functions in fields such as charging station management, smartphone services, car sharing and urban information management.

We are also attempting to build activities for creating unique values while developing a new vision with our viewpoint in a wide spectrum of fields including medical care, energy, agriculture and urban development. In such activities, we believe it will be necessary to handle an even wider variety of information, not confined to location-based information.

In this way, we intend to create various values in diverse fields through expanding the platform for location-based services, thereby helping to invigorate people's activities and lives and contribute to the creation of an affluent society.

7. Conclusion

This paper has presented a service platform for making use of location-based information (platform for location-based services). Using the platform for location-based services allows the users to make use of new services and create their own new services. In the future, we intend to further enhance the functions and expand the scope of application so as to realize the vision described above.

Some of this paper is based on the METI-commissioned project "Industry-University

Collaborative Software Engineering Practice Project 2009 (Software Development for Realizing High-reliability Cloud Computing [Demonstration Project for Achieving High Reliability of Data Centers concerning Technologies for Optimizing Computer Resource Operation]).”

References

1) Fujitsu: Fujitsu Global Cloud Platform “FGCP/S5”. (in Japanese).
http://fenics.fujitsu.com/outsourcingservice/saas/plat/sop/

2) METI: “Industry-University Collaborative Software Engineering Practice Project 2009 (Software Development for Realizing High-reliability Cloud [Demonstration Project for Achieving High Reliability of Data Centers concerning Technologies for Optimizing Computer Resource Operation])” Project Report. (in Japanese).
http://www.meti.go.jp/policy/mono_info_service/joho/downloadfiles/2010software_research/cloud_computerResource.pdf

Kyohei Tamai
Fujitsu Ltd.
Mr. Tamai is currently engaged in development of traffic information-related technologies.

Akio Shinagawa
Fujitsu Ltd.
Mr. Shinagawa is currently engaged in development of traffic information-related technologies.