

Solutions for the Location-Based Services

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Abstract: As a result of the project “Development of core technology for open LBS”, we developed several solutions such as personal navigation system, mobile game, and emergency system. In this paper, we explain the approach and architecture of these solutions and consider their meaning on spatial information bases and expectation in the future computing environments. The final goal of this suggested solution is to test the efficiency of our open LBS system and verify the applicability and usability in real application environments. Our approaches will be headed to the future ubiquitous computing environments.

Keywords: LBS, Solutions

1. Introduction

LBS(Location-Based Services) is defined as the services provided to the user based on the location of user utilizing mobile devices(cell-phone, PDA, etc.) in the wired or wireless telecommunication environments. There are several definitions made by the related organizations such as 3GPP(The 3rd Generation Partnership Project)[1], OGC(Open GIS Consortium)[2], and FCC(Federal Communications Commission)[3].

LBS is one of the emerging technologies in today's IT trends getting connected and mobile. Especially the concrete infrastructure of South Korea's wireless telecommunication has potentials for the progress of LBS industry. For the proliferation of location services market and industry, it is important to provide open and standard interface specification for platform, service, and contents to service providers and developers. We have been developing the platform and services conforming to the open standards such as OpenLS[2] and MLP(Mobile Location Protocol) by LIF(Location Inter-operability Forum)[4]. In the following sections, we briefly look at the system architecture and core technologies developed by the project “Development of core technology for open LBS”, and present the solutions designed and implemented on the basis of open platform for the several location services.

2. System Architecture

Location services are based on various kinds of technologies(Fig. 1). Telecommunication infrastructure composes the lowermost layer of the technology pyramid. Especially the wireless communication environment such as CDMA, IMT-2000, LAN, WAN, Bluetooth, and so on builds global network over the nation and make it possible push and pull the services to

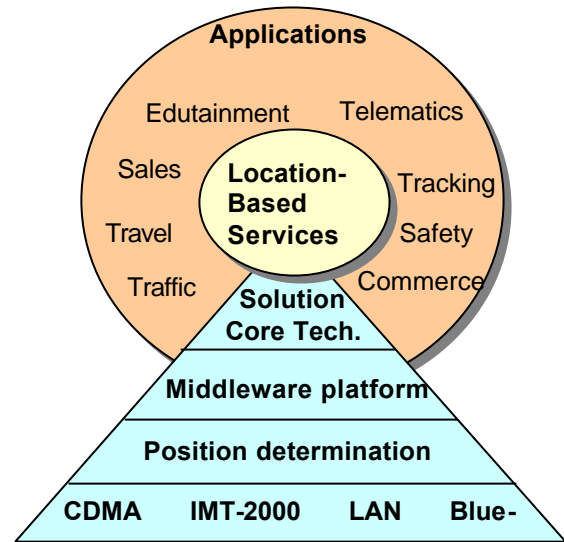


Fig. 1. Component technologies and applications for location-based services.

and from the mobile users.

Technology for the second layer is for the location determination or positioning. Positioning technologies can be categorized according to the coverage area as outdoor positioning and indoor positioning. Outdoor positioning plays key role in the most application areas. Some of the representative technologies are Cell-ID, E-OTD(Enhanced Observed Time Difference), E-FLT(Enhanced Forward Link Triangulation), and A-GPS(Assisted GPS). There are differences in the positioning accuracy and response time among these technologies so the application should be determined regarding these quality-of-service factors of each technology.

The indoor positioning technology is paid more attention today due to its applicability in ubiquitous computing area. This technology utilizes usually the infrared, radio frequency, ultrasonic wave, and vision system[5][6][7].

The middleware platform is the server acquiring and managing position-related information. The key role of this platform is to handle the huge size of position data fast, efficiently, and reliably. For this purposes the special database technologies such as moving object database and main memory database are utilized.

The core technology layer is to provide the common and essential functionality for various kinds of location services. The core technology is composed of the LBS-based component technology, contents transformation and transmission technology, and handset component

technology. These technologies are also based on several elementary technologies respectively.

On the top of the technology pyramid, is the solution technology placed. Through the solution technology, the various kinds of services over wide application areas can be implemented. The close look at the three technology layers: middleware platform, core, and solution is shown at Fig. 2.

3. Solutions

There are a lot of application areas for location-based services as shown in Fig. 1. These services are provided by the service-provider. Solution technology is to support service-providers by the core functional components developing the services. We developed solutions for three services: public emergency service, traffic information service, and entertainment service.

1) Location-based Emergency Solution

Nowadays, the number of emergency call made by mobile devices like cellular phone is getting more increased and the acquisition of caller's information including caller's location to provide the prompt rescue service is also needed more. To provide the emergency safety services such as E-911 based on the caller's location, we developed the PSAP(Public Safety Answering Point) solution system.

The overall operation architecture of PSAP is shown in Fig. 3. If a mobile user calls emergency service, the call is routed to PSAP via wireless network and PSTN(Public Switched Telephone Network). With the received caller's ID, PSAP requests caller's location to positioning gateway. Then the acquired caller's location is overlaid by map and displayed in the operation terminal. According to the emergency service necessary to the caller, the proper rescue command is issued to police or fire brigade. The rescue process is controlled by control terminal till the rescue event is closed.

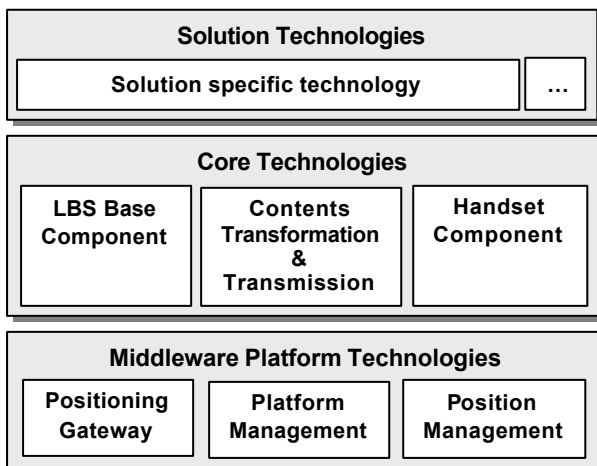


Fig. 2. Composing technologies of three layers for location-based service technologies.

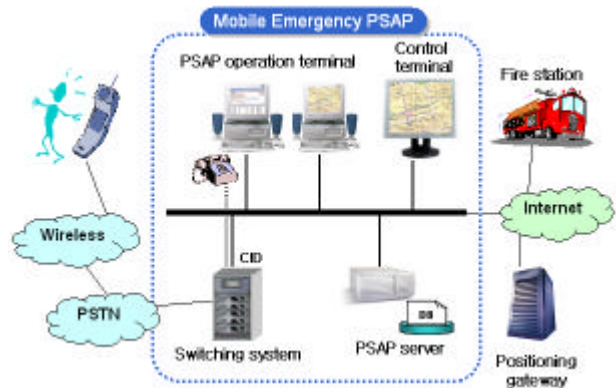


Fig. 3. Flow of mobile emergency call and the roll of PSAP

2) Location-based Traffic Information Solution

As traffic congestion increases, and road network get complex, the need to take advantage of the fast transportation route also increases. It will be more convenient for mobile user if the transportation and traffic information is provided according to the user's location. We developed several services especially for public transports such as bus, train, and subway. In addition to the routes of bus, train, and subway, the stations, bus stops, subway exits, and parking lots are stored and managed in DBMS. We developed seven services: Find near transport, Route information, Best path, Arrival time, Find facilities, Navigation, and Bookmark. The detail explanation of each service is shown in Table 1.

To provide the up-to-date traffic and transportation service, the route data must be updated as the routes and stops change.

For the arrival time service, the location of buses should be tracked in real-time. Several methods can be utilized positioning and tracking the bus position such as beacon or GPS. There are pros and cons among those positioning methods, for example the beacon-based method is relatively expensive because lots of beacons should be installed at every bus stop. GPS-based method

Table 1. Seven services for location-based traffic information solution

Service	Function
Near transport	Find bus stops or subway station near the user's location.
Route info.	Display the buses and train stops at the selected stop and station, and show route information of multi-modal transports.
Best path	Find best path from start to destination and multi-modal transport along the path.
Arrival time	Show the estimated arrival time of bus at the selected bus stop.
Facility	Show the map of facilities around the user's location.
Navigation	Notify at the stops when the user move on the bus to the destination stop.
Bookmark	Provide one-click service by bookmarking the path or destination or service which user prefers.

is relatively cheap and has advantages in out-door envi-

ronments to get the position data, there are errors in accuracy and above all, signal loss can occur especially in the downtown areas of moderate to large cities where a concentration of tall buildings at times occludes much of the sky from a street-level location[8].

3) Location-based Entertainment Solution

Location-based service has potentials applicable to various kinds of entertainment services such as game, chatting, tour guide, mobile coupon, and so on. Among these services the location-based mobile game is a promising item in the future market. Many scenarios for mobile location game are already introduced and some of them are patented as a new business model. We developed solution for a kind of combat game in which the participant players defeat enemies (other participants) located at the real position. A set of SDK for location game is developed and it contains interfaces for location, map viewer, user manager, network, sprite, push module, and external.

4. Conclusions

We developed technologies for the location-based services such as middleware platform, core functionality, and solution specific technology. Our system has open architecture conforming to the national standards so it has extensibility and interoperability. Several solutions are developed to provide the service-provider the core functional components specific to location-based services such as public emergency service, traffic information service, and entertainment service.

5. Future Works

We are now testing the performance of our system on the real location of mobile users. Some additional functionalities are going to be added to these three solutions and more solutions for other location services will be developed in near future.

To provide seamless services regard to the user's location, the indoor position of mobile user must be tracked. This seamless positioning has importance especially in the future ubiquitous computing environment.

Location-based services are based on the consideration that the mobile user's location is an important context surrounds user. To provide more intelligent and user-friendly services, other contexts should also be recognized. One of the important context is the user's emotion. There are researches on the wearable devices that recognize its wearer's affective pattern automatically[9]. To provide more sophisticated and customized services, system must know what its users want so the interdisciplinary research is necessary covering human-computer

interaction and LBS.

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