Location Based Services (LBS)

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ABSTRACT

Location Based Services (LBS) are developing rapidly in the mobile and information technologies (IT) fields. Increase demand to modern technologies and interest in utilizing geospatial information servers to provide useful information and services to mobile users though wireless networks plays a very important factor to LBS advancement.

Following a general introduction to LBS technology, this paper aim to understand location based services (LBS) technology and identifies the key components behind the service providing of the technology, and then shed some light on the limitation preventing the technology advancement in local market.

Introduction

The appearance of different technologies such as wireless networks, Internet, Geographical information systems (GIS) and Global Positioning Systems (GPS), have introduced a new type of information technology called Location Based Service (LBS).

Location Based Services is defined as the ability to locate a mobile user geographically and deliver services to the user based on his location.

The aim of this paper is to understand location based services (LBS) and identify its key components behind service providing then shed some light on the limitation preventing the technology advancement.

Understanding Location Based Services

Location is essential to how people relate and organize their world. According to Schiller J. Location based services can be defined as "*services that integrate a mobile device's location or position with other information so as to provide added value to a user*." So knowing your location or how far you are from a specific location would not be valuable by itself. Only if it can be related to other location which gives it meaning and value. For example, knowing that you are 3 KM from Melbourne University is good but to obtain a travel path to the university would be considered as value. Retrieving information about restaurants and cafes along the path would enhance the value better. The ability to modify the route in case of possible delays on the selected path adds another level of value. Moreover, knowing the geographical location of a person or object at any time would add a new powerful dimension to information Services. For example, it would be possible to use the yellow pages to know the location of store in the same time get the direction based on user location.

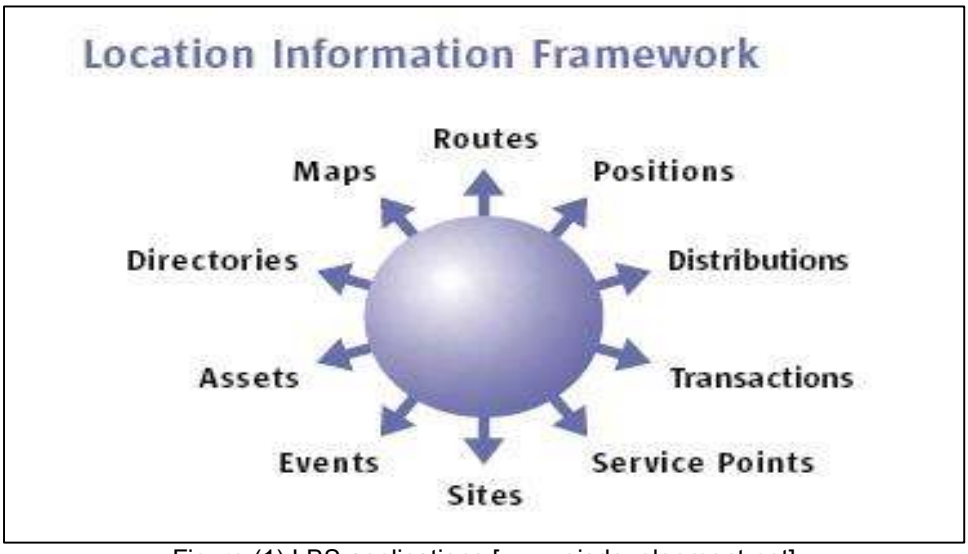


Figure (1) LBS applications [www.gisdevelopment.net]

LBS has a variety of applications that can be offered to organizations such as government, emergency services, commercial and industrial organizations for example, breaking news, traffic information, tracking and way finding see figure (1).

The number of services has no limits. However, the organization needs to evaluate the services and consider which service offer the optimum benefits to its organization.

LBS is distinguished and characterized by the ability to support the following factors:

- Itinerant: being able to offer services to a moving user such as car drivers, pedestrians and cyclists.
- Distributed: A way of providing a resource over a computer network that allows more than one machine to deliver a service, through the use of standard protocols and conventions that is known and obvious to the user.
- Ubiquitous: offering the same functionality or services at any location in the network.

LBS have three different levels. All these levels emphasize on location and time, for instance the position level requires the user current location. The Tracking level requires the user current and past location. The planing level requires the user current, past and future location.

LBS and Mobile Mapping Elements

LBS components are user devices, position technologies, wireless network, application server and geographical data server. All these components communicate together to produce a service to the mobile user. See Figure (2)

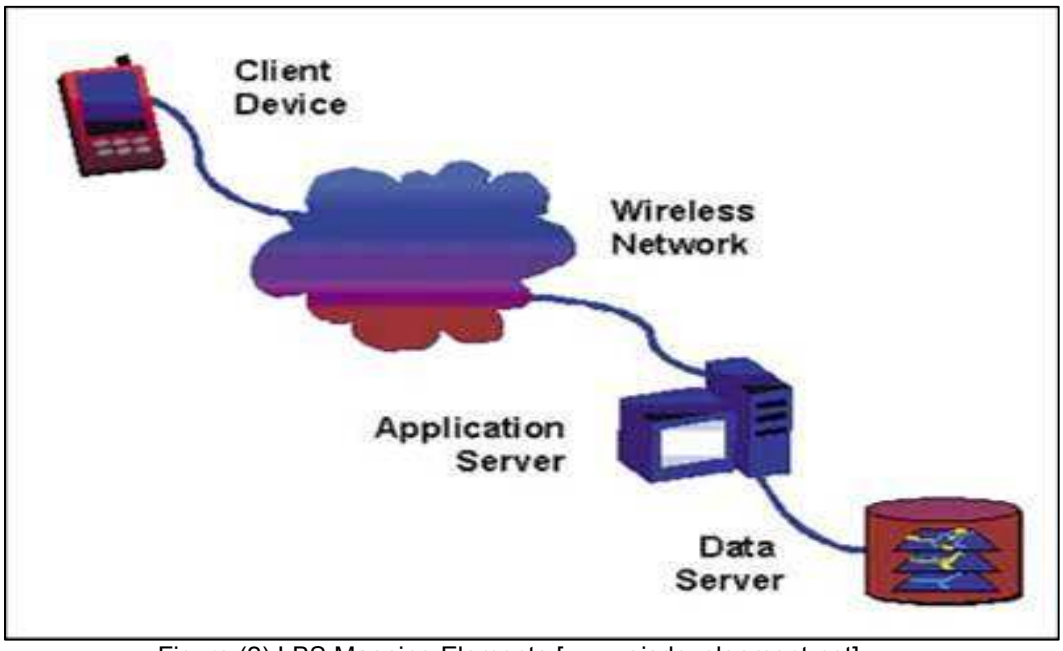


Figure (2) LBS Mapping Elements [www.gisdevelopment.net]

User Devices

The field of hand held devices with geographical applications is developing rapidly fast. The top end devises in the market have the following specifications:

- 320 x 480 pixels screen resolution
- 8 bit colour
- 256 MB of memory and 624 MHz

Also, there is a wide range of operating systems that depend on the type of wireless phone.

Wireless Application Protocol (WAP) phones

The WAP phone depends on the gateway to connect to the internet. These gateways have the ability to translate the WAP requests from mobile terminals into the web content or server and return the result back. The WAP uses the wireless markup language (WML) to display the result and content of the map. See Figure (3)

Figure (3) WAP & GPRS phones [www.nokia.com]

General Pocket Radio Service (GPRS) phones

General pocket radio service does not require a gateway to access web content. It uses the HTML to request maps directly to map server. However, GPRS phones are equipped with both technologies WAP and HTML. So the user can uses either the WAP to request maps then the request will go through gateway or uses HTML to connect directly to web content. See Figure (3)

IMODE phones

These types of phone receive the map information in similar manner to WAP phones the only difference between both technologies is, IMODE uses a subset language of HTML called (CHTML) in replace of (WML). Moreover, these types of phones are connected to the WAP always. See Figure (4)

Figure (4) IMOD phone [www.esato.com]

Personal Digital Assistance (PDA)

There are three types of PDAs categories:

- WAP browser PDAs: operates in the same manner to WAP technology phones.
- Windows CE PDAs: connect directly into the internet because of the built in softwares than enables data retrieval from server similar to personal computers.
- PalmOS Devices: operates on clipping map content from web server and present minimal map information.

Figure (5) PDA phones [www.pdaonlinecenter.com]

Electronic Piece of Cheese (EPOC) Devices

Phones that have EPOC operating system can connect to the internet directly or through WAP browser depending on the type of EPOC device used.

Figure (6) EPOC Phones [www.informit.com]

Positioning Technology

One of the most important elements in the LBS and mobile mapping technology is the ability to locate object on earth or wireless networks.

There are various approaches to determine objects positions

- *Terminal based approaches*
  - Global Positioning System (GPS)
  - Assisted Global Positioning System (A-GPS)
  - Enhanced Observed Time Distance (E-OTD)
- *Network based approaches*
  - Cell Global Identity (CGI)
  - Time of Arrival (TOA)

Global Positioning System (GPS)

GPS is the worldwide radio navigation system based on 24 satellites orbiting the planet earth. These satellites are controlled by ground station to monitor the GPS operational health and their exact position in space.

GPS uses these satellites to calculate positions accurately to a matter of meters. The positions are measured using the receivers themselves or processed on the network then the actual position is sent to the user.

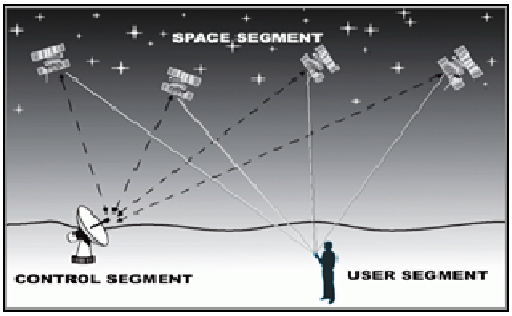


Figure (7): GPS segments [from www.garmin.com]

Assisted Global Positioning System (A-GPS)

Network assisted GPS actually uses fixed GPS receivers that are regularly spread over network having a 200KM to 400KM intervals to fetch data received from the terminal. This allows the AGPS receiver to make timing measurements form the satellites without using the decoded massage. Fetching the data by the receivers reduce the time to first fix (TTFF) from the range of 20-45 seconds to 1-8 seconds range.

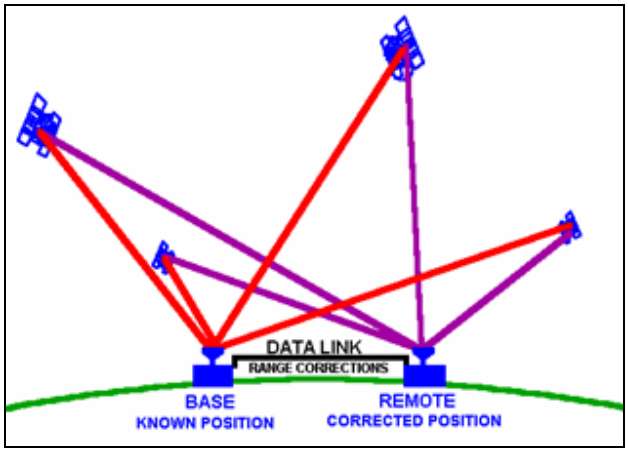


Figure (8): Differential GPS [www.colorado.edu]

Enhanced Observed Time Difference (E-OTD)

Enhanced Observed Time Difference operates by locating receivers called location measurements units (LMU) on multiple sites in the wireless network. These units contain accurate timing source that require special signal from EOTD software enable mobile. The difference in time stamps received from both cell sites and mobile softwares are combined to produce the estimated location of the handset. The accuracy of the EOTD range between 50-125m, and does not require a clear sky such as GPS

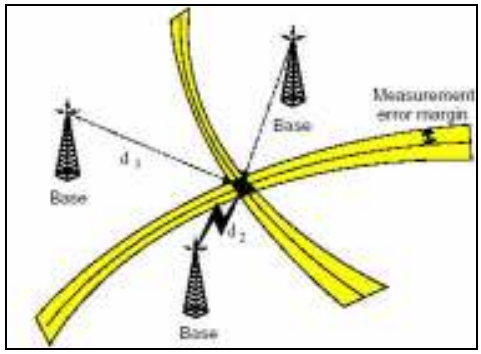


Figure (9) EOTD [www.jamesbeldock.com]

Cell Global Identify (CGI)

In this location identifying approach, the Cell Global Identify (CGI) determines the location of mobile client within any cell network based on the station used. Using this method by itself the accuracy depends on the size of network. Using the method along with time difference between transmission and arrival information, provide an estimate of 500m accuracy to base station and the direction is circular radius or section of circular band. Moreover, further research shows achievable potential of 200m accuracy on the ground and the technique is used on existing network.

Time of Arrival (TOA)

The time of arrival (TOA) technique function by measuring the precise arrival time of mobile radio signal at three or more different cell stations. Since the radio waves travel at fix rate, it is possible to calculate the position based on the arrival time. In Multipath areas it is necessary to use four different cell stations to overcome the Multipath effect.

Positioning is a very important key element in the location based services users and suppliers need to know what type of position technology fit their use or service such as availability, accuracy, vulnerability and continuity. All these aspects help the user decide on the type of position technology that fit his requirements and help in the understanding of advantages and disadvantages of each technology.

Wireless Network

Wireless is unguided radio, microwave and optical signals that transfer information between locations without physical connection. For example, Bluetooth is a wireless technology that delivers information on short spatial distances no more than 10 m. see figure X to know the different type of wireless networks

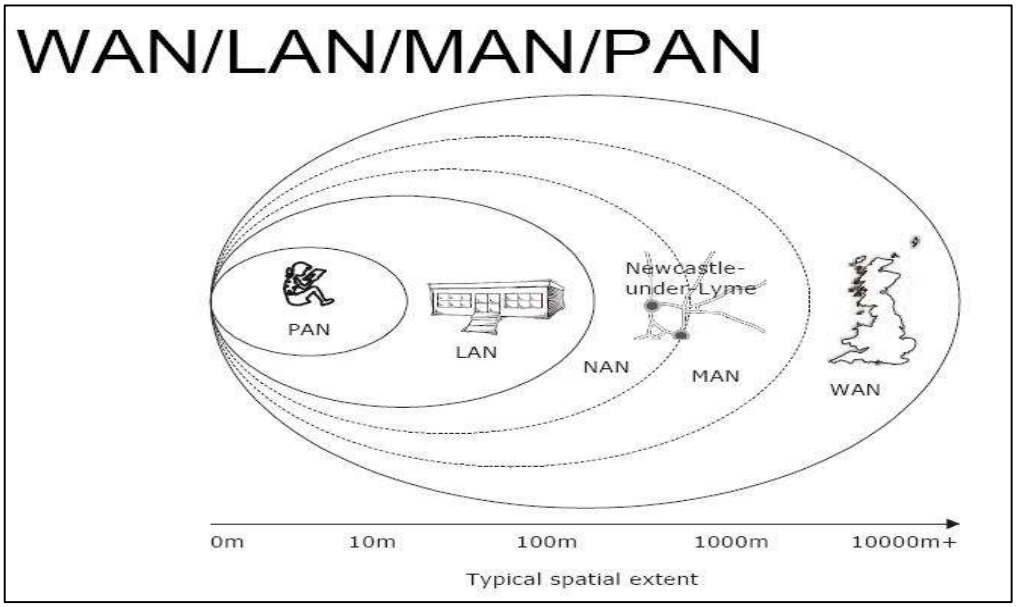
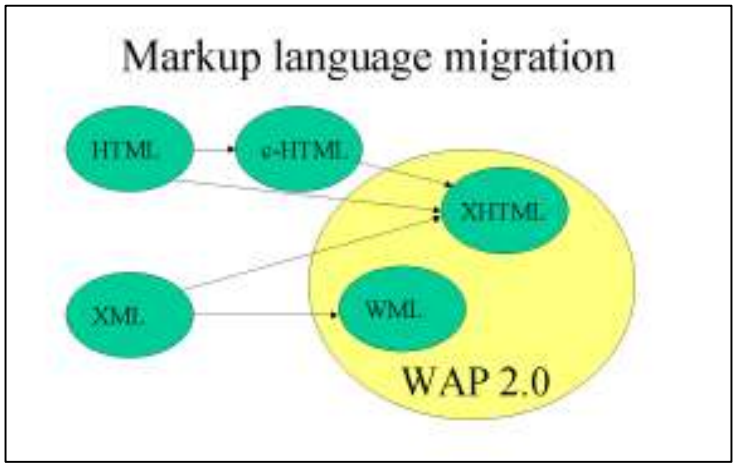


Figure (10) Wireless networks

In mobile mapping the wireless application protocol (WAP) is used to transmit information in the network. The WAP specification encompasses a simple and compact version of extended markup language (XML) called wireless markup language (WML).

The language is suitable for issuing request to servers and return result since WML support Wireless bitmap (WBMP) file. In general, this allows users to request geographical services from WAP phone and the result would be a display page containing a map in the form of WBMP.



Figure(11) WAP 2.0 [www.gisdevelopment.net]

Moreover, the hardware capabilities of user devices continue to improve, software applications are developing rapidly and bandwidth limitations are

accounted and the focus will shift to HTML and XML and geographical markup language GML.

Application server

The application server resides between the geographical data server and wireless network. It arranges the clients' requests through the wireless network and fetches the information coming off the geographical data server. Moreover, it is recommended that LBS servers have the following specifications:

- Rich functionality: it offers a wide range of services such as high quality maps and its attributes, proximity analysis, geocoding and routing.
- Good performance: performance is important to show the capabilities of the server in handling request simultaneously.
- Scalability: is measured based on the number of application requests and the very large data sets and ability to add processing capabilities without interrupting operations.
- Extensibility: the mobile applications are very new in the industry and it is hard to forecast the future. So it is very important that the server can support new services and increased users.
- Reliability: the server need to be available 24/7
- Standards: wireless systems are developing rapidly; standards such as XML are beginning to emerge. So building system that support the language will help for better systems in the future.

Geographical database

The geographical database is the holder of the geographical information such as routing, topography, geocoding and maps. For example, commercial database system such as spatial oracle or DB2 can be used to store and manage the geographic information.

Geographic services

- Geographic service is a server-based application that delivers data and/or processing to clients on demand.
- It receive requests from clients (pagers, phones, Pocket PCs, PCs, etc.) for geographic data and/or processing (e.g. make a map, geocode an address, download data for an area).
- The query, analysis and mapping operations are performed on the server, or in the case of more advanced clients, possible on the client as well as the server.
- In the either case the results are displayed on the client. The results could be a map, a list of geocoded addresses, or a data file.

Applications in Local Market

LBS is a new technology, it covers a wide range of applications. The potential of the service can improve the aspects of life. LBS offer services to all different

organizations such as military, government, emergency services and industrial organizations. Some of these applications applied:

- Traffic coordination and management: uses the past and up to date positional data to identify the traffic jams while in the same time offer an alternative route to the user to avoid this jam and get to his destination in the fastest time. In San Diego they use SMS notify users of the condition of the traffic on highways.
- Shopping: if a user enters the parameter of a mall and for example set his/her status into the shopping mode, it is possible for the sale departments to send promotional coupons to users and provide a better services and marketing to their products.
- Job dispatch and Fleet management: using the remote tracking of taxis and trucks to locate the position of the customers. So knowing the proximity of the truck or packages would provide a better service to the user. For example, a user now would be able to track the location of an important document send through DHL and know precisely the location of the document in real time using the internet tracking ID.
- LBS games and entertainment: for example, treasure hunting games where the players compete to recover the missing treasure. The missing treasure is not real but it is placed in a physical location. By observing the players it can be possible to determine the treasure is found by which player. Moreover, it is possible to change the treasure into another type of game.
- News to your location: it is possible to deliver the breaking news to the user and keep him updated for a specific issue irrelevant of his location using his handheld device. This can be done using the TV streaming services or SMS. However, these services require a very fast data transfer connection to work properly.

All these services operate by either pulling or pushing a service or both services. So if a user is requesting the service then the service utilize the geographical position of the wireless device to provide information related to the location of the user when he/she pull the information such as “what is the closest hypermarket?” which a user sends to a yellow page. On the other hand, push services refer to location services that utilize the position of mobile devices to send information to offer services or alerts for example, emergency weather alert.

Limitations

There are some limitation that prevent and affect the advancement in LBS and mobile mapping. The speed promised by the service provider not all devices has the same capabilities to reach the service provided speed, communication between the service provider and wireless manufacture would allow the user to have a transparent knowledge of the mobile specifications needed such as 3G phones. Moreover, the speed offered by service provider is measured on theoretical speed not a real life example, which lacks the trust of the service. Moreover, the prices of download using mobile devices are considered to be very expensive. The service

provider needs to take advantages of bundling and packages or any other promotional service offers to reduce the downloading price.

Topology is necessary to effectively realize the full potential offered by most location based services applications. For example the traffic information services were you want to avoid a traffic queue that happened suddenly on highway and receive an alternative route. Based on Open GIS Consortium (OGC) this example considered to be very complicated since it involves the following:

1. Create a planned route
2. Periodically get device location
3. Position device on appropriate transportation network (usually streets)
4. Examine planned route for obstacles
5. Compute work-around if obstacle is discovered
6. Process and present a work-around
7. Obtain background road networks with street and place names with scale and map up date as device moves
    a. Highlight planned route
    b. Highlight work-around route
8. Explain the obstacle

The implementation of real-time dynamic topology, within a database, is necessary for capturing and managing this intelligence in real-time.

Still the use of mobile device in internet browsing did not reach the capabilities of computer desktop which LBS may be able to offer in the future. Some problems in the WAP appear in translating some HTML sites into WML.

Conclusion

In conclusion, locations based services promise a very bright future considering all the key aspects of technologies required to operate the LBS available in the market. The ability to overcome some of the obstacle created by market pressure and time of availability could be identified through extra research and development.

Moreover, the number of people that it can reach is far from expectation due to the number of mobile users around the world. There would be large revenue outcome for the service provider and other technologies participants. So the time is right for location based services and the infrastructure is available. However, LBS need to identify the targeted market and provide solutions to its customers.

Finally, the recent year technologies identify LBS as predominant area of deployment of geographical data management.

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