Literature Survey

Introduction:

With the current rapid increasing use of smart phones, the mobile location based service market is growing to the point that location-based services are now a standard feature on many mobile devices. The greater availability of GPS phones, reduced prices, and app stores have all contributed to the rapid growth of location tools. For example, with the iPhone 3G now priced at $99 [19] (with service agreement), GPS-enabled phones are within the reach of many consumers. As long as these phones grow in popularity (they will), then location-based services will spread until, one day, they become as common as the cellphone itself.

Why Location Based Service?

A Location-Based Service (LBS) is a mobile computing application that provides services to users based on their geographical location. From [1] we can see LBSs can range from simple form as “Tell where the nearest subway is” to “Give me the location of the taxis within 5 km range” and even “Notify me when the super market ‘A’ gives a sale” also maybe soon will be like “tell me if there is a sale in a shop when I walk past.”

Characteristics of Location Based Services:

According to [1] the first generation LBS were reactive and client-server focused, where typically user would ask an application some information and in return would get a response. The next generation LBS are proactive and interactive between users. For example: users may subscribe for certain services such as, relevant information can be sent to users based on their location rather than users having to manually search for it.

In [2], they pointed out the basic components of such location based services. According to their decomposition of such services there are five basic components:
**Mobile Device:** Smart Phones, PDA, Laptops fall into this component. They are the tools the user can use to make any service request.

**Communication Network:** To send the user request to LBS providers and bring back the response, a mobile communication network is needed.

**Positioning Component:** For LBSs, user position detection is one of the key components. User's position can be detected by GPS or communication network.

**Service and Application Provide:** The service provider processes the service request. Such services calculate the user position and find a suitable result for user query based on the user location.

**Data and Content Provider:** Usually service providers do not always store all the information that maybe requested by the user. Therefore LBS result data will be usually requested from maintaining authority, or business and industry partners.

In access to the general components in [2] they also list some capabilities of LBS that are also very important from user point of view:

- **High Performance:** Delivering answers in second if querying information from internet and databases.
- **Scalable architecture:** Support thousands of concurrent users and terabytes of data.
- **Reliable:** Capable of delivering up to 99.999 percent up-time.
- **Current:** Support the delivery of real-time, dynamic information.
- **Mobile:** Availability from any device and from any location.

**Examples of Location Based Services:**

Location-based services offer many opportunities. For the mobile user, some examples of location-based services are:
• Requesting the nearest business or service, such as an ATM or restaurant
• Receiving alerts, such as notification of a sale on gas or warning of a traffic jam
• Finding a buddy

From [3] and [4] we found some classifications of LBS as given by:

• **Resource tracking with dynamic distribution**
  Taxis, service people, rental equipment, doctors, fleet scheduling

• **Resource tracking**
  Objects without privacy controls, using passive sensors or RF tags, such as packages and train boxcars

• **Finding someone or something**
  Person by skill (doctor), business directory, navigation, weather, traffic, room schedules, stolen phone, emergency 911

• **Proximity-based notification (push or pull)**
  Targeted advertising, buddy list, common profile matching (dating), automatic airport check-in

• **Proximity-based actuation (push or pull)**
  Payment based upon proximity (EZ pass, toll watch)

**Different Models of Location Based Services:**

Many research works have been conducted for LBSs to propose different architecture, schemes to improve performance in terms of scalability and reliability and to ensure user's privacy. We may classify the models according to their area of improving the basic LBS structure.

Below we present a tabular representation of different LBS schemes. In the column header we present specific improvement area and in the row header we specify the research work implementing them.
We found from the discussion in [5] that the current LBSs are rigid as they cannot make good use of the contextual information. Services are provided in inappropriate times and also user preferences are not considered. E.g. in a restaurant finder application users actually want to find the “best” restaurant according to their current preferences and context. Existing location-based query processors reduce the meaning of “best” to be only the “closest” restaurant. To solve this problem they propose a context-aware location based service. The main idea of the architecture is to embed various ‘context information’, in service trigger mechanism and service itself.

Some of their provided examples include:

Dynamic route guidance service; which ensure user to arrive at destination in the shortest time. This needs to adjust previous route according to the traffic condition.

Another example is restaurant queries; traditional restaurant queries only consider the distance, while we aim to change to provide better results by considering not only distance but also user preferences (e.g., prices, restaurant rating, and dietary restriction, history selection), environmental context (e.g.,

<table>
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<th>References</th>
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<th>Improvement in terms of networks load and link failure</th>
<th>Implementing caching for LBSs</th>
<th>Location-based Service Discovery</th>
<th>Privacy in LBSs</th>
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Table 1: Different models to improve LBS

Context-Aware LBSs:

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Some of their provided examples include:

Dynamic route guidance service; which ensure user to arrive at destination in the shortest time. This needs to adjust previous route according to the traffic condition.

Another example is restaurant queries; traditional restaurant queries only consider the distance, while we aim to change to provide better results by considering not only distance but also user preferences (e.g., prices, restaurant rating, and dietary restriction, history selection), environmental context (e.g.,
time, weather and current traffic condition) and restaurant context (current waiting line, closing time).

If we consider only server-client approaches for context-aware location service, it can be seen that the server will soon be overloaded because the amount of information to be handled. To solve this issue [6] proposes to use P2P networking technology. They propose a network called LL-network (Location-based Logical Network). In the LL-Net, any network terminals including fixed terminals, mobile terminals, ubiquitous sensors, and network-enabled appliances, could be a peer.

In [7] the proposed framework is composed of service provider, service requester and service broker. The service providers are context-aware systems constructed for each domain. The service requesters are mobile devices such as smart phones. The service broker provides services to find service providers based on the current location of the user and to connect services. The Service Broker is the key component of LOCA web service framework. It provides appropriate context-aware services by performing matchmaking based on the location information of service providers and service requesters.

[8] Proposes an approach for context-aware LBSs where the concept of Web 2.0 technology (e.g. wikis, blogs, web feeds, podcasts) is used. In this approach a restaurant owner, for example, will then be able to set up a localized service for his restaurant on his own and in an easy and simple way. The menu of the restaurant could be presented to people approaching the restaurant on their mobile devices. Furthermore, one could be able to make a table reservation by a smartphone. The aim is to find a way for service providers to bind both existing web-services and their own new services to locations in an uncomplicated and easy way, which does not require any specialized knowledge. Users shall have a context-aware access to all services according to their needs.

**Approaches to improve LBSs models for network failure or high network load:**

[10] Proposes an agency based location aware service scheme. In case of any service breakdown, node and link failure the agency can manage service. Their proposed system model divides a wireless network into several clusters. Each cluster is actually a local wired network and has a fixed active node,
which comprises of the agency. The agency consists of several agents and a knowledge base. The knowledge base is updated by manager agent. They suggest that agent based location discovery services offer flexibility in terms of the learning capabilities of the agents, scalability as the proposed model is scalable to any network, efficiency, adaptability as the nodes adapt to changing network conditions such as node movement, service break-down, node failure and link failures and maintainability as the agent components can be easily debugged and replaced.

[11] Presents an infrastructure that supports location aware services. This infrastructure is based on a proposed location operating reference model, which addresses many major aspects of building location aware services. Three key components of the infrastructure are: the location server, a moving object database and a spatial publish/subscribe engine. Different components of this infrastructure are built to meet different layers of and expose APIs to developers who can then build other components that can plug into the model. In short the composition of the components facilitates the development of various location aware services.

In [12] a new type of location based web service architecture is proposed which is named as ‘Person Wide Web (PWW)’. Based on the geographical location of the mobile user PWW effectively recognized the location specific web resources. Among so-many resources in the WWW, only the things closely located to the user, make up his PWW. It is stated first that the most widely used LBS such as map search, navigation search have different system architecture from each other and also users have to use different client software for each of them. On the contrary web based LBS does not require any specific client software. For web based LBS, all the LBS providers need to establish their own web site. PWW will automatically recognize geographically effective web resources and will notify them to the users in a periodic manner. Another mechanism is provided in [13] which gives example of ‘The Time-User-Location Information Processing (TULIP) System’ that represents an initial design of a location-aware service system consisting of one or more servers that provides location-context sensitive world wide web (WWW) pages to clients with standard web-browsers and some additional software. In the proposed system a client with a wired or wireless connection to the Internet uses its browser to log onto a TULIP server, available on the web. The login procedure will also generate a special user profile that is sent to the server. After login, the server will initiate a
separate side-channel socket connection to the client and will request the client location, as determined through its LSM. Once the server has received the requested location data, it will generate web pages that contain hyperlinks based on that location. These pages are derived from a spatial database with geographic information and knowledge from the user profile.

**Implementing caching in LBS:**

Some approaches were found where caching mechanism were proposed for LBSs. [14] Proposes a new caching technique preserving the privacy of user. Their proposed approach tells about an anonymizer, this will be a trusted third party that will perform query blurring to produce a set of different LBS request objects. This trusted third party will also be another server where the user will actually submit his request. The anonymizer performs spatial or temporal cloaking (blurring) to convert a single point into a spatial region. This spatial region along with the set of multiple request object types is submitted to the LBS. Thus, the exact location and query type of the user is shielded from the LBS. The LBS returns a set of candidate results instead of the exact result. Caching is used at the anonymizer in LBS to save communication and computation cost and to preserve privacy for snapshot and continuous queries.

[15] Proposes a cache management technique for improving user privacy protection, saving computation power and decreasing communication cost. This paper also proposes the cache management technique for location based service using trusted server. The fundamental idea behind their methodology is to leverage the cached results from prior spatial queries for answering future queries at the location cloaker. The location cloaker is an intermediate agent which can be trusted by mobile users. The location cloaker receives continuous location updates from mobile users and stores their locations with an index structure. In addition, the location cloaker also anonymizes the location of any query requesting mobile user to a cloaked region before forwarding the query to related location-based service providers. Any user identity related information in the query is also removed by the location cloaker during the cloaking process. They propose if the location cloaker can cache the received query results from service providers, the cached results can be utilized to fulfill new spatial queries from mobile users. By applying this cache based solution, mobile users’ privacy protection can be further improved. Since the location cloaker can solve a certain number of queries.
without forwarding them to service providers, it would be much more difficult for adversaries to launch correlation attacks.

Another cache management scheme is proposed in [20], where a proxy server for geographically partial matching queries is used. They define the term geographically partial matching as matching two query results if the differences between the geographical locations of the query initiators are below a certain threshold. In that case they are considered to be in the same region and their query result will be the same disregarding the boundary results. So when two locations are partially matched their query result will be served from the proxy server to share the load of the primary server. The proxy server will actually be a region server.

[21] Proposes a peer selection based service lookup technique for areas with sudden increase in population density. This also resembles the caching mechanism, where in case of increased population density, no request to server will be made, and rather a peer will be selected for service lookup. They assume that the user query and query result is passed through the user cell’s base station. Whenever a sudden dense in population is detected a mobile host manager in the base station will start the formation of an autonomous system from a number of selected mobile nodes and will populate those mobile nodes with service data record. And in such a situation a mobile user issuing a service request will be assigned to the autonomous system.

**Location-based Service Discovery:**

Some of the research works considered discovering appropriate LBS an important area. A work related to this was found in [9], where they presented context-aware and location-based service discovery protocols for vehicular networks. They help drivers to find services located in a desired region of interest, such as restaurants with their menus or gas stations with their price lists located close to the driver’s destination. A driver generates a request for a service. In the service request the user specifies the location where he wishes to find the service. The requester sends the service request L−VRD packet to the neighboring Roadside Routers. The neighboring roadside routers of the requesting vehicle receive the L−VRD packet and separate the service information from the routing information. The service information is
processed by the service module and the routing information is handled by
the routing module.

**Privacy in LBSs:**

Location privacy is a big concern for LBSs, as user location is revealed to a
third party. Many research works have been conducted to find effective ways
to preserve user privacy.

In [16] they proposed an approach in which users are allowed to use
randomly generated pseudonyms in the control to the access to their location
information. The location information, a time stamp and an associated
pseudonym is stored at a location server and only the service providers that
possess the correct pseudonym can access the location information. Users can
change who can access the location information by simply changing the
respective pseudonyms associated with the location information. [17]
Proposed to use ‘Dummies’ to protect the location privacy in LBSs. In the
proposed technique, a user sends the true location data with dummies, i.e.,
false location data, to a service provider that will reply with a message for
each received location data. The user only extracts the necessary information
from the reply messages. In this manner, the service provider cannot tell the
true position data, thus leading to the protection of user’s location privacy.
[18] Proposes a new approach regarding the location privacy issue of LBS.
Their proposed solution states that a query initiator can select itself or one of
the k - 1 agent in its ad-hoc network as a query requestor, the query initiator
remains k-anonymous. In addition, the location revealed to the location
service provider is a rectangle instead of an exact coordinate. This can ensure
a level of safety regarding location privacy, but still this also considers the
traditional server to client based approach for LBS.
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<tr>
<th>Model Name</th>
<th>Network Connectivity Required</th>
<th>High Query Traffic Handling</th>
<th>Handle Link Failure</th>
<th>Considers User Preference With Details</th>
<th>Considers User Privacy</th>
<th>Implements Caching (Not requesting to 3rd party service provider)</th>
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<td>A Location Based P2P Network, Kaneko Y. et al. [6]</td>
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<td>Web Service Framework with Service Broker, Ahn C. [7]</td>
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<td>Caching With Geographical Partial Matching, Huang C. [20]</td>
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<td>Peer Selection for Sudden Population Density Increase, El-Nahas A. et al. [21]</td>
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<td>Privacy Preservation With Dummies, Kido H. et al. [16]</td>
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<td>Privacy Preservation With Pseudonym, Rodden T. et al. [17]</td>
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<td>Privacy Preservation with k-anonymity, Hashem T. [18]</td>
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Table 2: Comparison between Different Models

Conclusion:

We presented here an overview on what works have been conducted regarding location based services. The various areas of the LBSs, including privacy, context-awareness, performance of the service etc. are presented in the above discussion. From our observation we found that all of the proposed
approaches relating to LBS are client to server based, which makes requests over the net and gets result over the net.

References:

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