Check for updates

By Bharat Rao and Louis Minakakis

Evolution of Mobile Location-based Services

Utilizing user location as a key determinant of information requirement needs.

Mobile commerce is poised to make a qualitative leap. Knowledge of the end user's location will be used to deliver relevant, timely, and engaging content and information. For mobile network operators, location-based services represent an additional stream of revenue that can be generated from their investments in fixed infrastructure. For the end user, these services can help reduce confusion, improve the consumption experience, and deliver high-quality service options.

With the proliferation and widespread adoption of mobile telephony and data, service providers have been eager to exploit customer information they have acquired over time. User location has traditionally been difficult to pinpoint and use due to its inherent dynamism and unpredictability—the customer's location in physical space. With regulatory pressures and the rollout of new technologies integrated into lightweight mobile devices and terminals, pinpointing location is quickly becoming an exact science. Carriers are being forced by regulators to accurately position wireless emergency calls, through E911 in the U.S., and E112 in the EU [3]. Agile technologies like GPS, mobile cell phone identification techniques, and network triangulation

Google Ex. 1011, p. 001

A KEY *driver of LBS will be a degree of fit between the system's technical feasibility and the overall marketing strategy guiding its usage.*

allow carriers to zoom in further on customer activity in a narrowly defined physical location. As these capabilities become more accessible, accurate and real-time, various service opportunities have been conceptualized. These location-based services (henceforth referred to as LBS) have therefore emerged as an important component of m-commerce strategy. The LBS subscriber base is forecast to reach 680 million customers globally by 2006 [1]. Predictions are that LBS will generate over $32 billion in Europe by 2005 [9]. Numerous firms have already emerged to tap into this growing opportunity.

Platforms, Technologies, Standards

A key driver of LBS will be a degree of fit between the system's technical feasibility and the overall marketing strategy guiding its usage [2]. Several technologies and platforms (including PDAs and mobile phones) need to be connected and integrated with the wireless network infrastructure, ranging from different types of servers to back-end databases. LBS providers will need to focus on blending software, hardware, and wireless connectivity into a plan for serving LBS content. Designing low-cost, reliable, and high-quality systems from a complex puzzle of disparate software, hardware, and connectivity components presents a challenge. However, success in this area will accelerate networking effects that lead to widespread adoption, an increase in the customer base, and lower operating costs.

Mobile Network Platforms. Several options are available with current mobile network platforms for delivering LBS; these competing technologies and techniques are briefly reviewed in Table 1. The central element in the network design focuses on the degree of accuracy in targeting a user's location. A number of geo-location technologies promise an accurate pinpointing of an object or person's position on earth [12]. Three strategic considerations assume importance while choosing and deploying these technologies. These include the range of coverage and scalability of applications; the degree of service quality that can be established and maintained at a reasonable cost; and the careful alignment of the overall technology costs with the types of services customers will pay for.

Type	Methodology	Pros	Cons	Industry Applications
Cell Identifier (Cell ID)	Base station uses radio frequency signals to track mobile device	Relatively widespread infrastructure	Hard to pin down user's exact location to a few meters	Wireless network providers, police force, banking government security, welfare
Global Positioning Systems (GPS)	24-satellite network	Outdoor precision within five-meter range	Expensive User device must be in direct line of sight Device needs special embedded chips	Military applications, commercial applications like real estate, security, police force (not as successful in consumer settings)
Assisted Global Positioning Systems (aGPS)	Enhancement over GPS Perpetually locates device and coordinates data flow, unlike GPS	No "cold starts" Faster fix on location	Expensive User device must be in direct line of sight Device needs special embedded chips	Military applications, commercial applications like real estate, security, police force (not as successful in consumer settings)
Broadband Satellite Network	Relies on low-earth-orbit satellite architectures to create a global network	Lower signal latency with user devices	Complex to maintain	Military applications, commercial applications like real estate, security, police force (not as successful in consumer settings)

Table 1. Mobile network platforms for identification.

Demand Drivers. The emergence of broadband wireless infrastructure, through third-generation (3G) wireless connectivity and wireless LANs (Wi-Fi), has broadened aspirations for delivering multiple types of mobile services. Devices have evolved from simple talk-based services (first-generation mobile phones) to incorporate functions like downloading music and ring tones, multimedia messaging, and video calls. Public Wi-Fi networks are beginning to provide location-based information and services to targeted audiences. With the evolution of voice over WLAN

Google Ex. 1011, p. 002

(VoWLAN), it is possible the cellular network backbone will be replaced by wireless broadband. Meanwhile, phones are converging with PDAs (the Palm i705, Palm m500 series, and the Handspring Treo, for example) to create a new breed of mobile devices providing capabilities originally found exclusively within the various disparate devices. NTT DoCoMo's hugely popular iMode service, which provides always-on Internet connectivity, is delivered through a proprietary GPRS network [7]. As the demand for multimedia mobile connectivity grows, and as operators proliferate, it is likely that LBS will become a critical element of a mobile operator's marketing strategy and contribute to the bottom line.

The Customer Value Proposition

While the idea of using information about customer location to deliver focused services is extremely appealing, the area is fraught with risks and caveats. First, there has been much hype generated about LBS, and some of its benefits are either exaggerated or infeasible [11]. Second, limitations in technologies and aggregation capabilities mean LBS is not about to become widespread for the next year or more. Third, LBS can potentially intrude on customer privacy. Finally, there has not been a sustained effort in developing sustainable business models that sufficiently address and enhance the customer experience [6].

Location, Location, Location. Location plays a key role in determining the type and nature of human activity. Location can determine consumers' information needs and their product and service choices. If a mobile service provider knows the end user's exact location, and is able to target useful (and billable) information at that point in time, the benefits can be mutual. However, knowledge of the user's location is only part of the problem. Depending on where, when, how, with whom, and why customers are navigating in physical space, their needs will vary. A baseball fan attending a game with friends is likely to have a completely different LBS need/consumption profile from that of a person on a routine trip to the supermarket. Even if the LBS provider was able to push information or advertising with great reliability to these customers, they might have an extremely difficult time figuring out what the customer is doing or wants at that location in real time. One can attempt to classify such information needs along criteria, such as location type, amount and type of time available, individual or group needs, the context of the immediate physical neighborhood, personal preferences, and time of day. These can be matched with a variety of service offerings.

There is an urgent need for sophisticated mobile marketing techniques based on detailed knowledge of customer profiles, history, needs, and preferences. Information existing in customer databases developed by retailers like Amazon.com, for example, can be used in parallel with location-based information. New services can also emerge at the interface of the customer and other third parties wishing to deliver location-based services, including retailers, media companies, stadiums, and restaurants. These incremental enhancements will be delivered and monetized through existing delivery platforms where the mobile operator has a billing relationship with the customer or end user. NTT DoCoMo's iMode service offers a preview of this "walled garden" type of model, where third-party service providers are aggregated under a branded iMode umbrella.

Demand Level	Typical Services	Typical Business Models
Consumer Demand Location and Navigation Personalized Content	Maps, Driving Directions, Yellow Pages	Subscription-based services, pay-per-view, syndication, micropayments
Niche Consumer and Business	Maps, Shopping Locator Services, Coupon Discounts, Alerting services	Subscription-based services, advertising, revenue-sharing, micropayments
Industrial/Corporate	Supply Chain Management, Inventory Management, Customer Relationship Management, Intelligent Transportation, and Systems Infrastructure	Application service provider, consulting services, infrastructure provider

Table 2. Business opportunities in LBS.

Addressing Privacy Concerns. Digital fraud has substantially increased as more consumers use the Internet to complement offline purchasing. Similarly, unauthorized resale of personal information, intrusion and theft of customer databases, and the unauthorized use of lost or stolen mobile devices all represent potential threats to the adoption of LBS. LBS providers must alleviate consumer privacy fears by implementing secure network and encryption technologies to curb illegal activity and by developing clear communication strategies to interact with customers and allay their fears. Providers need to balance privacy concerns with the overall costs of implementing LBS.

Business Opportunities in LBS

LBS can be classified based on the type of underlying customer need they seek to serve and also the type of information that can be delivered in a given space-time configuration. The major drivers of demand will be mass-market consumers; consumers in niche specialty application markets; business and industrial customers with specialty needs; and a large variety of objects and inventory that can be identified and tracked in physical space. We describe typical services and business

Google Ex. 1011, p. 003

ADVANCES IN *modular software and coding, along with capabilities in customization and personalization tools, will be critical to seamless integration of location information, customer needs, and vendor offerings.*

models for each of these demand categories in Table 2.

"Where am I" Queries. One major type of consumer demand relates to information about location and navigation, such as "Where am I?" and "How can I get there?" queries. Maps, driving directions, directory and yellow page listings, and business descriptions in a given geographical radius all constitute the answers to such queries. These types of LBS have taken off in Japan, while they are a more recent phenomenon in the U.S. Some industry analysts suggest the Japanese context is unique and may not be replicable elsewhere. For example, in a dense urban area like Tokyo, there are few street names. GPS capabilities allow customers to find their way to their destinations and alert friends and colleagues to their whereabouts. Further, as Japanese employees get transferred frequently, they use mobile location-based services to familiarize themselves with their new surroundings. In the U.S., for example, the car could become the focus of LBS providers. Getting detailed maps and directions, real-time alerts on traffic conditions, and information about highway services like gas, food, and lodging will be an important benefit to drivers. Auto manufacturers, hardware vendors, software developers, and third-party service providers eagerly anticipate the next stage of evolution of the car as a mobile computing platform, as well as the emergence of a telematics industry along with it [5].

At this early stage, however, these developments have not yet come to fruition. Instead, there has been a market rollout of relatively inexpensive handheld homing devices. These include devices like golfing assistants mounted on golf carts that provide everything from course maps to teeing tips, fish finders that combine sonar and GPS capabilities to allow anglers to pinpoint locations of schools of fish, and so-called people locators, which enable parents to locate children in urban areas and shopping environments [8]. The key to unlocking the potential of such services is their application in a networked setting. Combining devices with other proximate and distant cousins, networked applications could potentially multiply the range and utility of these services.

Point of Need Information Delivery. The second type of demand relates to usable, personalized information delivered at the point of need. This includes information about new or interesting products and services, promotions, and targeting of customers based on more advanced knowledge of customer profiles and preferences. Service providers will need access to customers' preference profiles either through a proprietary database (and find the best way to deliver the information) or use an arrangement with a LBS provider (who matches customer profiles to vendor offerings). For this type of activity to take place transparently and efficiently, there needs to be further integration in the types of software that link these multiple parties. Advances in modular software and coding, along with capabilities in customization and personalization tools, will be critical to this kind of seamless integration of location information, customer needs, and vendor offerings.

Niche Consumer Applications. A third major type of demand relates to specialized applications aimed at certain concentrated segments of the market. This can include demand by individual consumers, as well as business and industrial buyers. At the individual consumer level, several specialized LBS are under development. A number of them combine the inherent technological possibilities with detailed knowledge of the characteristics and idiosyncrasies of target segments and will be deployed at the network level. One can expect early-stage devices like golfing assistants and fish finders to evolve beyond their current capabilities and provide more features, functionality, and real-time networking. Target segments could include sports enthusiasts, outdoorsmen, and families, for example, and delivered services could be extremely rich and narrow in their focus. One early example is Gate5, a software developer in Berlin, whose "People Finder" program lets users of handheld devices display maps with the location of other cell phone users. Once a person is located, the two cell phone users can chat on their phones in real time. The service is targeted at mobile carriers, whose customers must opt into the program, which works on handsets and PDAs with

Google Ex. 1011, p. 004

SMS and email capabilities. While some of these services may raise the hackles of privacy advocates, a number of business models will rely on opt-in or pull-based delivery.

Industrial and Corporate Applications. The fourth major type of demand will emerge from business customers. In fact, a quiet revolution has been taking place in this category as businesses begin to use and deploy location-based technologies to track material, people, and projects using innovative means. Much of this change can be attributed to three major developments [10]. First, the widespread adoption of relatively inexpensive bar-code scanning means products moving through the supply chain can be digitally identified, both in terms of their underlying characteristics (product number, dimensions, weight, price) and their movement in the supply chain (real-time location, speed of movement, bottlenecks). Second, the connectivity revolution has enabled the networking of portable wireless devices and wearable computers that can provide new types of usable knowledge to buyers, suppliers, manufacturers, retailers, and other members of a globally dispersed supply chain. Combining identification and connectivity, along with new types of inference algorithms and techniques, will enable seamless, efficient, and transparent movement of raw materials and products through the global supply chain. From the location-based technology point of view, an extensive range of enabling technologies will make this happen in conjunction with existing network infrastructure. Finally, Swartz [10] posits another type of revolution, that of large-scale inference capabilities. This is similar to the concept of ambient intelligence or pervasive computing proposed by other advocates arguing that almost all types of physical material and devices will be embedded with smart sensors and effectively form a large-scale intelligent network. This network will sense customer needs and deliver them "intelligently" irrespective of time and space.

Even with current technologies, industry analysts expect significant demand in areas like fleet tracking, asset management, personal and asset safety, network fault detection and maintenance, and the provision of CRM and other tools to an increasingly mobile workforce. One example that incorporates numerous location-based features includes a prototype system recently deployed during the Pentagon's $700 million reconstruction and restoration project. Based on a wearable computer system, this project gathers, stores, and analyzes data about daily room-by-room inspections at a construction site and seeks to improve communications between on- and offsite supervisors by creating more accurate and timelier inspection checklists, location-specific task recommendations, and real-time reports and work orders. Development of such dynamic applications will accelerate once the convergence of identification, connectivity, and inference are truly in place.

Conclusion

LBS can be a new source of revenue opportunity for multiple stakeholders in the mobile value chain. Given existing technical limitations like device form factors and the speed of data access, combined with human limitations like reduced consideration sets and the need for speed and convenience, LBS must deliver relevant, targeted, and timely information to consumers at the time and place of their choice [4]. Competitive advantage will accrue to LBS providers who focus on superior customer experiences, distinctive, secure, and high-quality service, and branding. C

References

1. Analysis. *Mobile Location Services and Technologies*. February 13, 2001.
2. Dru, M-A. and Saada, S. Location-based mobile services: The essentials. *Alcatel Telecommunications Review, (first quarter*, 2001), 71–76.
3. Geer, D. The E911 dilemma. *Wireless Business and Technology* (Nov./Dec. 2001), 40–44.
4. Kannan, P.K., Chang, A.M., and Whinston, A.B. Wireless commerce: Marketing issues and possibilities. In *Proceedings of the 34th Hawaii International Conference on Systems Sciences* (2001).
5. Kulatilaka, N. and Venkatraman, N. Strategic options in the digital era. *Business Strategy Review 12*, 4 (Apr. 2001).
6. Nohria, N. and Leestma, M. A moving target: The mobile commerce customer. *MIT Sloan Management Review* (Spring 2001).
7. Rao, B. *NTT DoCoMo: Defining the Mobile Frontier*. Institute for Technology and Enterprise, Polytechnic University, New York, June 2000.
8. Spagat, E. Handheld homing devices: GPS hits household gadgets. *Wall Street Journal* (Sept. 11, 2002).
9. Strategis Group. *European Wireless Location Services*. Apr. 2000.
10. Swartz, J. E-commerce and megamachines: Identification, connectivity, and inference engines. *Technology in Society 23*, (2001), 159–175.
11. VanderMeer, J. Hype vs. reality of location-based services: LBS at the end of 2001. *DirectionsMagazine;* www.directionsmag.com/article.php?article_id=144.
12. Varshney, U. Addressing location issues in mobile commerce. In *Proceedings of the 26th Annual IEEE Conference on Local Computer Networks* (2001), 184–192.

Bharat Rao (brao@usa.net) is an associate professor of management at Polytechnic University in Brooklyn, NY. **Louis Minakakis** (louis.minakakis@jpmorgan.com) is a technology officer with JPMorganChase Bank in New York.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

© 2003 ACM 0002-0782/03/1200 $5.00

Google Ex. 1011, p. 005