The Current State of Commercial Location-based Service Offerings in Australia

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Abstract— **Location-based services (LBS) provide geographic data for a variety of purposes, and through numerous devices such as mobile phones, GPS navigation systems, palm pilots and increasingly desktop computers. Presently, there is scant information relating to the current state of the LBS market, specifically location-based service applications in Australia. This study makes use of usability context analyses to examine Australia's three leading telecommunications operators- Telstra, Optus and Vodafone- with a view to providing an overview of the types of services and solutions presently offered and targeted at the consumer, business and emergency segments. There are two units of analysis (i) the company at the upper level, and (ii) the usability context at the lower level. A number of general, regulatory and future considerations and questions are also posed in the paper to indicate the future research direction.**

Keywords- location-based services; LBS; mobile GPS; mobile social network; employee monitoring; emergency management

I. INTRODUCTION

A. Location-based Services

Location-based services (LBS), a domain in the field of mobile commerce, is defined as the applications and tools that combine geographic coordinates with services, thereby providing value-added solutions to users [1-4]. The history of LBS can be traced to the 1970s, when the US Department of Defense commenced using the NAVSTAR Global Positioning System (GPS) for military purposes in order to position people and objects [5]. In the 1980s, GPS was made publicly available to industry in order to stimulate innovation, which encouraged its deployment in existing services, most commonly mobile phones during the 1990s[4]. Presently, GPS-enabled devices have become common among government, business, emergency management and general consumer groups.

The World GPS Market Forecast Report illustrates the global penetration and pervasiveness of GPS technologies, anticipating that the majority of navigation systems will be 'shipped' to the Asia-Pacific region by 2012 [6]. Furthermore, the report maintains that while portable navigation devices (PND) have had more than 90% market share since 2007, this figure is expected to decline in the future with the increasing prominence of GPS-enabled handsets. Such forecasts in GPS technologies validate the need for assessing current telecommunications operators, who provide LBS on GPS-enabled handsets, allowing for the current state of the market to be measured. Prior to this appraisal, however, is the requirement to articulate how LBS can be categorized depending on the given context.

B. LBS Classifications

Location-based services can be classified in many ways. A common distinction is that between pull and push services, each of which implies different technological considerations. For instance, push solutions require the coordinates of the individual to be provided continuously in real-time, whereas pull services involve the individual providing updates on a selective basis when required [7]. Additional, and typical, classifications of LBS include person-oriented versus device-oriented, network-based versus handset-based solutions, reactive versus proactive and also the market segment to which the LBS application is targeted [1, 4].

For the purpose of this paper, an account of the broad LBS applications in the Australian market will be presented (that is, consumer, business and emergency), with a particular focus on the three major telecommunications operators providing mobile GPS services. The research objective is to review each operator to determine the current state of their offerings and the industry landscape in general. In short, where are commercial LBS offerings at, relative to their brief introduction in the Australian market?

II. LITERATURE REVIEW

Many national and international studies concentrate on LBS applications in certain contexts, such as emergency management, health care, tourism, government, business and consumer situations [7-10], where the positive applications and driving factors behind LBS usage are addressed. In a book centered on mobile business strategies, Paavilainen expresses the business and consumer motivations for deploying LBS [7]. For instance, corporate users can potentially extract value from LBS applications from efficiency and cost management perspectives, through the use of such services in fleet and customer relationship management situations. Similarly, consumer groups are generally motivated by factors such as convenience, time/money saving and general interest, an example of which is the use of GPS portable navigation devices to reduce the amount of time required to reach a particular destination. Additional user groups of interest to this study include emergency services, whose main driver is the immediate access to timely location information in crisis situations.

Regardless of these motivations, the technical, legal, political, ethical and social implications have been the focus of numerous studies, all of which illustrate important issues that should not be overlooked in the introduction and adoption of LBS [11-13], such as the need to maintain location privacy [14], thereby ensuring that personal privacy is also protected.

Furthermore, studies such as Michael (2004) focus on LBS applications in the following domains: consumer, business and emergency, providing a concise method of classification in studies concerning LBS applications [2]. Other authors point to certain areas such as business applications. For instance, Rao and Minakasis concentrate on the corporate implications of LBS in view of how such technologies can best be provided by organizations in their existing services to consumers [15], while others like Zeimpekis et al., and Zeimpekis and Giaglis are concerned with real-time fleet management and predicating unforeseen incidents in urban locations [16, 17]. A similar method of grouping LBS applications is adopted throughout this paper to aid in the high-level categorization of the LBS services/solutions available in Australia, and provide structure throughout the data collection process. Additionally, while this paper draws on the above studies to frame the research, it is distinguishable in that it documents the LBS applications available in Australia, as is explained in the subsequent section.

A. Gap in the Literature

Presently, there is scant information relating to the current state of the LBS industry in Australia. While a number of location services have been released to the market and are currently being tested by business, consumer and emergency management segments, the available services have not been clearly documented in terms of the associated cost(s), technology, general function, and importantly the usability context. This paper attempts to address this gap in the literature in order to record the existing state of the LBS industry in Australia, thereby providing a future framework for evaluating additional operators and LBS providers both within Australia and internationally. The study will provide additional value by presenting a number of questions for further consideration, based on the outcomes derived from the study.

III. METHODOLOGY

The method used for this study is primarily a self-administered survey of telecommunications operator websites that will yield qualitative results in the form of descriptive usability context analyses and tabular descriptions. The chief objective is to allow for current LBS offerings to be reviewed, comparisons to be made between vendor services, and the current state of the market in Australia to be depicted in order to determine the kind of location services that have diffused into the marketplace.

This study makes use of usability context analyses to review the present state of LBS offerings in Australia. A similar approach has been employed in the research areas of GPS tracking and monitoring [18] and RFID implants [19], and the method is widely used in industry as a component of the product development cycle [20]. Traditionally, this technique encourages an understanding and assessment of the context in which a product will be used [21], in addition to establishing usability requirements and targets to assist in product development and improvement [22]. This paper seeks to employ usability context analyses to allow for the evaluation of existing vendor offerings by means of exploring the major application areas or usage categories-consumer, business and emergency-, as previously identified. Therefore, the study will use two levels of analysis, the first being the telecommunications operator, and the second being the usability context (that is, business, consumer and emergency).

In conducting this research, multiple e-research techniques were utilized, specifically the evaluation of online content in conjunction with an analysis of available materials such as marketing datasheets, technical specification files, general textual information on website pages, audio/visual demonstrations and other documentation found on the official websites of the operators. The data collection process was carried out between January and February 2009, by surveying the official websites of Telstra (www.telstraenterprise.com), Optus (www.optus.com.au) and Vodafone (www.vodafone.com.au), including any relevant subpages and documentation contained within each.

The e-research technique employed in this instance refers to the process of utilizing the internet to collect and analyze the large volume of data available online, allowing the data to be converted into knowledge and enabling new areas to be explored [23], namely determining the present state of commercial LBS offerings in Australia. The focus areas throughout the e-research process are illustrated in Figure 1.

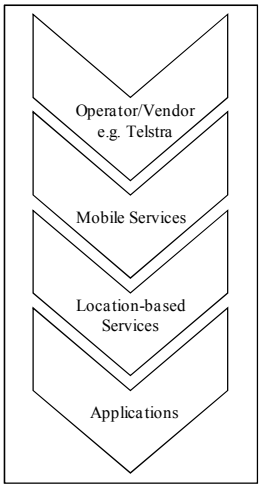

Figure 1. Research focus areas.

A. Format of the Outcomes

The outcomes of the research are intended to be qualitative, in which a descriptive review will be presented for each vendor based on the derived questions that will satisfy the research objective, presented in Table 1. These

structured questions serve to act as the basis for data collection, and provide scope and consistency to the online research efforts.

In conducting a self-administered survey of this nature, it is imperative that a list of response categories be established, relevant to the overall research topic [24]. For the purpose of this research, and in order to preserve consistency throughout the survey process, response categories have been constructed for each question, as can be viewed in Table 1.

TABLE I. RESEARCH QUESTIONS AND RESPONSE CATEGORIES

Question	Response Categories
Who is the vendor?	Telstra, Optus, Vodafone
What is the application?	Business, consumer, emergency
What is the LBS product/ service/solution?	Official brand name, as marketed by the relevant operator
How much does it cost?	Price of the service offering, measured in Australian dollars
What are the associated devices?	List any technologies required to deliver and utilize the product/service/ solution
How does the technology work?	Description of how the product/service/ solution operates, including high level information

B. Data Quality and Credibility

The data collected throughout this process will take into account issues of quality and reliability to ensure the findings are valid and objective. Quality will be maintained by cross-referencing the collected data against the following quality dimensions: accuracy, currency, completeness and consistency [25]. This will determine whether the data is correct, up-to-date, adequately answers the proposed research questions, is valid when cross-checked with other materials, and is therefore suitable for inclusion in the study.

This study is focused on the use of private documents, which can be regarded as any file created by and for an organization, which may include documents used internally by company employees or alternatively be disseminated to the public [26]. Consequently, the reliability of such documents is a major consideration, as commercial organizations often present their offerings in a positive light when releasing files for public viewing [26]. In analyzing the online artifacts, the research will focus on extracting data that is aligned with the previously identified questions, disregarding marketing materials that are solely used for promotional purposes and are subjective in nature in order to retain credibility during the data collection process.

IV. VENDOR REVIEWS

The objective of this section is to describe the outcomes of the data collection phase, providing an overview of the LBS marketplace in Australia at the LBS application level through a set of vendor-specific descriptions.

A. Telstra

1) Whereis Navigator

Telstra's Whereis Navigator service can be applied in both consumer and business settings; however, it is specifically targeted at enterprise groups that are seeking to improve the management of their workforce by utilizing location data. Essentially, the Whereis service is accessible on any GPS-enabled compatible handset such as the BlackBerry 8800 and Nokia N95 [27]. The notable features of this solution include the ability to access multiple navigation options including, but not limited to, voice and map-based navigation. The system also allows physical features to be located in the desired area(s), including tolls and points of interest. With respect to the mapping application, the software must first be downloaded onto the appropriate device prior to use [28].

2) Xora TimeTrack

Xora TimeTrack is an LBS application intended for business users, for both enterprises such as construction, and government to support field workers [29]. The service itself is part of Telstra's remote worker management package, which is centered on the concept of providing instant access to location data, which is viewable via a web-based interface through a series of maps and reports. Similar to the Telstra Whereis Navigation service, Xora TimeTrack requires a GPS-enabled compatible handset to operate. Xora is offered in three versions: Lite, Business Plus and Gold, which are distinguished by the number of core features offered [30].

3) Trimble GeoManager

While Xora TimeTracker is solely focused on business applications, GeoManager is a component of Telstra's mobile resource management offering, which is also suitable for emergency management purposes [29, 31]. This service requires an in-vehicle GPS unit to be installed, which interacts with an internet-connected PC to transmit real-time information, thereby allowing relevant data relating to employees and emergency units to be viewed [31]. Location information is accessible on a dedicated website using a series of maps and reports, as is the case with the Xora TimeTracker. The maps and reports primarily display information relating to travel distance and speed, which can consequently be monitored by employers.

4) Public Safety Solutions

Telstra's Public Safety Solutions accommodate the needs of emergency management groups through the use of purpose built services such as the @Roads GeoManager [32]. Unlike the previously profiled Telstra offerings that can be adopted for business applications, the @Roads GeoManager explicitly targets the needs of safety professionals that require vehicle tracking, locating and reporting capabilities in crisis or time-critical situations. Through the use of in-vehicle navigation systems, wireless devices and the Telstra Next G network, vehicle information can be transferred to the relevant supervisors [32].

B. Optus

1) Mobile Business Services

Optus offers a number of location-based services for organizations wishing to manage their mobile workforce, the most notable in this instance being Optus SimPoint [33]. Optus SimPoint falls into the category of Mobile Business Services, and can be used to determine the location of field staff and provide SMS communication capabilities. This

hosted solution, which utilizes GSM triangulation and integrated SMS functionality, ensures that employees can manage interactions with their field staff through a dedicated website [34-36]. A standard Optus mobile phone is sufficient for operating Optus SimPoint.

2) Mobile Satellite Services

Optus Mobile Satellite technologies, in general, are intended to provide land and mobile satellite services to customers, all of which are equipped with GPS location and tracking capabilities [37]. The three major services offered include Optus MobileSat, Optus MobileSat SatCUG and Thuraya Mobile Satellite, all of which are chiefly applied in business scenarios, excluding the Thuraya Mobile Satellite which is also targeted at general consumers [38-40]. Diverse technologies are required to install and utilize each of the solutions, as discussed below.

a) Optus MobileSat

Optus MobileSat delivers mobile phone coverage for voice, fax and data across Australia and approximately 200km out to sea [38]. This particular solution is part of Optus' integrated communication solutions, and requires the Optus MobileSat S2 Satellite Telephone with an external GPS in order to provide location data. The pricing structure for this service (refer to table two) encompasses a number of components such as product price, call price, connection fee, monthly fee, and optional/additional service charges [41]. MobileSat is typically employed in business contexts.

b) Optus MobileSat SatCUG

Optus MobileSat SatCUG is similar to MobileSat; however, it can be classed as a secure radio broadcast channel, although it also supports GPS tracking capabilities [39]. The private radio channel is restrictive in that it can only be accessed by up to 127 users for communication and location tracking purposes in organizational or business settings. The solution requires an Optus MobileSat S2 satellite telephone with SatCUG software, a PC and 2-wire telephone, microphone, and satellite radio [42]. With respect to the GPS functionality, this solution enables relevant personnel to monitor the location of SatCUG users and assets, while also allowing the users themselves to obtain their location details using their handset. The pricing structure is similar to that described for Optus MobileSat [43].

c) Optus Thuraya Mobile Satellite

The Optus Thuraya Mobile Satellite differs from the previous two examples, in that it is not limited to business use but rather can also be purchased by general consumers. Essentially, this service offers border-to-border satellite telecommunications services in over 110 countries [44]. The handsets required are the Dual Mode SG-2520 and Single Mode SO-2510, each of which contains an in built GPS [40]. In terms of charges, users are required to purchase either of the identified devices, and will also incur a monthly access fee and other call charges [45]. Presently, a subsidy is available on the cost of the handset for eligible customers, as part of the Australian Governments initiative to make satellite technology accessible and affordable to individuals living/working in remote parts of Australia.

3) Google Android/HTC Dream

Android is a free and open mobile platform developed by the Open Handset Alliance, an alliance of over thirty companies such as Google, Vodafone, Toshiba and eBay [46, 47]. The applications supported on the Android stack include, but are not limited to, an integrated browser, a contacts database, support for traditional multimedia formats, and importantly in this instance GPS capabilities which are hardware-reliant [48]. Android was publicly demonstrated in early 2008 [49], and is compatible with selected handsets, specifically the HTC Dream device. The Android platform was originally scheduled for launch in the Australian market by Kogan Technologies during January 2009; however, this was delayed due to future interoperability concerns [50].

Android was recently (mid-February 2009) made available by Optus on the HTC Dream telephone to complement their existing range of personal mobile offerings. The Android-enabled device features a number of preinstalled applications including Google Maps and Gmail, with the ability to download additional services such as social networking software to extend the default functionality [51]. Presently, this service is targeted at the consumer market, where a range of plans are available depending on internet and data usage requirements[52, 53]. Android is exclusively provided by Optus in the Australian marketplace at present.

C. Vodafone

1) Vodafone Compass

Compass GPS is the primary location-based service provided by Vodafone that offers in-car and pedestrian navigation capabilities, which can be applied in both consumer and business settings [54]. This GPS navigation system can be used on a number of devices such as selected Blackberry, Nokia and Samsung handsets. Notable features include the ability to access audio instructions and save favorite locations. Furthermore, map updates are automatically provided to Vodafone Compass customers [55].

2) Vodafone Pocket Life

Pocket Life is a joint initiative between Vodafone and Pocket Life [56], and is essentially a mobile social networking offering that integrates GPS capabilities with the traditional form of social networking. Social networks essentially represent the relationships or ties between individuals, in both personal and professional contexts [57]. Tools such as Pocketlife can be described as mobile social networking services, or technologies that facilitate the creation of a social network or community through the use of wireless and mobile communications [57]. For instance, Pocket Life users are able to exchange information, photographs/images and location details with one another in real-time. The tool can be described as an opt-in service, which requires the consent of both parties before location information can be shared [56]. Pocket Life is presently

intended for personal, consumer use, and requires a mobile phone and internet-enabled PC [58].

V. Discussion and Future Considerations

From the data collected it is evident that Telstra, Optus and Vodafone each offer location services to the Australian market in all three usability contexts- consumer, business and emergency, as is illustrated in Figure 2. While there is generally an overlap between consumer and business services (they are the most common), emergency management applications tend to be independent.

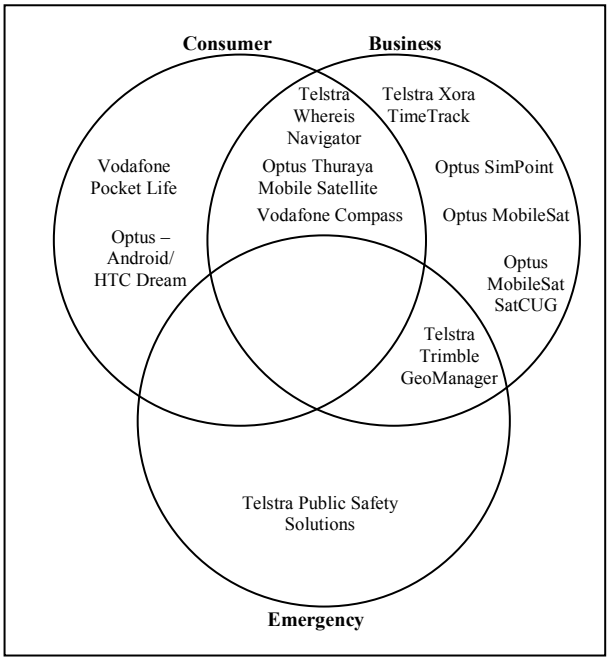

Figure 2. Applications of LBS in Australia and the associated offerings.

A. Consumer

In-vehicle and pedestrian navigation systems appear to be the most common LBS uses where consumers are concerned. The notable trend in the consumer market is the move toward connecting individuals and facilitating the sharing of location data in a social networking setting, as is demonstrated by Vodafone's recent release of Pocket Life. The nature of consumer applications is such that the services are available on an opt-in or optional basis, allowing individuals to make a conscious decision to utilize the location services. That is, the consumer in this instance can be classified as a 'voluntary' user, as they are able to choose to utilize the LBS, typically for convenience purposes such as personal navigation [59]. However, there is insufficient regulation at this point governing the use of these technologies; an issue that requires further attention to ensure that an individual's personal privacy is maintained. For example, what is the net effect of a parent loading location service software on their child's mobile phone and being able to track their every move in real-time? Or what of an overprotective tech-savvy husband who wants to check up on his unsuspecting wife? What are the consequences of friends constantly tracking each others' whereabouts using GPS-based social networking tools?

B. Business

Business applications are largely focused on the provision of employee location details, and the use of navigational capabilities to guide employees in performing daily activities that require car travel. The motivations for businesses in introducing such technologies are for potential efficiency and productivity improvements which are at times linked with remuneration, and also the ability to monitor individuals for accountability purposes in a professional setting. Some organizations, on the other hand, integrate LBS into existing processes in order to determine the location of employees for occupational health and safety purposes in emergency situations.

Unlike consumer services, business services are compulsory if an employer purchases the tools, and enforces GPS usage across the organization. That is, compulsory audit trails and checks can be imposed, with the employee being held liable as a result of the inferences made by their employer, based on the location data. Therefore, when compared to the consumer scenarios, employees in this instance can be classed as 'mandatory' users as opposed to 'voluntary' users. Mandatory users can be defined as those individuals that are required to utilize a specific LBS service [13, 59].

In this instance, an employer is granted an increased amount of control over employees simply through the ability to monitor location details over time. This calls into question the issue of trust, as this form of tracking can be considered a contributing factor to lack of trust in professional relationships. For instance, what are the implications of an employee being constantly monitored by their employer? How does this increase in employee control affect an individual's performance levels and the nature of their working relationship with the employer? Furthermore, is there the concern of unfair dismissal or treatment as a result of being at a particular location during work time?

A notable point in this instance is that individuals are typically protected by some form of agreement or arrangement with their employer; however, a crucial consideration is that LBS provide employers with geographic details, and do not necessarily represent what may actually be occurring at the location. Privacy, security and accountability are all major factors for future research, as are issues of workplace monitoring/surveillance and the associated implications. For instance, preceding studies have been conducted that consider the privacy and trust-related consequences that emerge with the introduction of workplace monitoring regimes, maintaining that excessive levels of monitoring can potentially result in a decline in professional relationships from a trust perspective [60].

C. Emergency

Emergency applications, on the other hand, are centered on the instant and accurate provisioning of location and other relevant data in time-critical situations, including the use of

GPS and mobile devices to coordinate vehicles and determine those that are closest to an emergency scene [61], in addition to the provision of systems to alert emergency professionals of a crisis. Importantly, emergency situations are characterized by the need for extensive amounts of communication, and the transmission of relevant information and support services.

In view of this research, a number of questions must be contemplated, such as how and will telecommunications operators in Australia cooperate to deliver an integrated emergency solution in the interest of citizens, as presently a single suitable offering does not exist? How will accountability be dispersed amongst the operators? What is the role of governments in the delivery of such services? Who will fund the implementation of such services?

Furthermore, these queries must be evaluated in conjunction with the social and regulatory implications that will likely emerge as a direct consequence of introducing new emergency services. For instance, in a related study that profiles mobile technology solutions for emergency management applications, the authors maintain that presently there are no standard regulations to manage the deployment of mobile alert systems in emergency scenarios, resulting in numerous privacy and other concerns [11], which must further be evaluated in the context of this study.

VI. Summary

Based on this research, the following questions must be considered in future studies: While LBS infrastructure is setup and available in Australia, why are there no widely deployed tools? What services will be introduced next for each LBS application, and what are the associated implications of such technologies? Can future trends be predicted for the Australian market? What are the rules/regulations governing existing applications? Are the rules/regulations adequate in protecting individuals, particularly in terms of privacy? Are we prepared for emergency LBS technologies?

VII. Conclusion

Location-based services (LBS) provide spatial data for a variety of purposes, and through numerous devices such as mobile phones, GPS navigation systems, palm pilots, and IP-enabled devices, the latter of which is an emerging trend in LBS and related technologies. This study demonstrated the consumer, business and emergency applications currently available in Australia, through a review of Telstra, Optus and Vodafone offerings.

The study found that business and consumer applications are prevalent, and in many cases overlap, with the services being utilized by both types of customer groups albeit for distinct purposes. For instance, while consumer applications tend to be optional and used for convenience purposes, business applications are compulsory in nature and are generally enforced by employers to gain organizational benefits and improvements. Furthermore, emergency applications were identified as the least common, given the intended audience and the nature of the service.

The common theme across all applications is the need to consider the implications of existing LBS technologies, particularly in terms of the legal and social aspects. It is particularly important that further research be conducted to assess regulatory issues, and ensure that present and future regulations account for the current state and developments within the LBS industry. Furthermore, similar market reviews and studies are required on a continuous basis, to ensure that the industry landscape is understood at all times.

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