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This paper focuses on the growing need to consider the implications of humancentric applications of precise location based services (LBS). As newer positioning technologies are introduced into the market with a greater level of location accuracy, and existing technologies are utilized in an integrated fashion to overcome limitations, issues pertaining to the use and potential misuse of location information rise to the fore. The scenario planning methodology provides a robust approach within which to consider future possibilities based on current market developments. To this end, document and content analysis play an important role in the collection of facts used to illustrate a given set of scenarios. The contribution of this paper is in providing adequate evidence toward precise LBS and in identifying those attributes that will guide the formation of the narrative descriptions in future research. The preliminary results of the study indicate that societal, ethical and legal implications need to be given greater attention as precise LBS applications will be increasingly used in the tagging, tracking and tracing of humans.

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This paper focuses on the growing need to consider the implications of humancentric applications of precise location based services (LBS). As newer positioning technologies are introduced into the market with a greater level of location accuracy, and existing technologies are utilized in an integrated fashion to overcome limitations, issues pertaining to the use and potential misuse of location information rise to the fore. The scenario planning methodology provides a robust approach within which to consider future possibilities based on current market developments. To this end, document and content analysis play an important role in the collection of facts used to illustrate a given set of scenarios. The contribution of this paper is in providing adequate evidence toward precise LBS and in identifying those attributes that will guide the formation of the narrative descriptions in future research. The preliminary results of the study indicate that societal, ethical and legal implications need to be given greater attention as precise LBS applications will be increasingly used in the tagging, tracking and tracing of humans.

1. Introduction

Wireless technologies which allow users to move around while maintaining the ability to access a network and its services, now claim a significant degree of attention by both industry and academia.[1] In this vision one particular attribute gains critical importance: location. The ability to pinpoint a mobile user's location creates a new class of applications and services. These location-based services (LBS) exploit the known location of a user to provide services dependent on their geographic context and personalized needs. This area has potentially wide-ranging implications for society. In fact, LBS have been described as being "without a doubt one of the most exciting developments to emerge from the mobile telecommunications sector."[2] However, perhaps because it is so new, there has been limited investigation into exactly how LBS may change our world. This paper aims to provide the groundwork for a deeper exploration describing how humancentric applications of precise LBS could change the world of tomorrow, based on the current state of development.

2. Background

The term LBS covers a variety of applications, but all have at least one thing in common; they all rely on knowledge of a user's location to provide tailored services or information by means of a wireless device. Personalization may be based on other things in addition to location, like user profiles and the surrounding context.[3] However, the way in which this information is actually determined varies, as does the required level of accuracy. This paper is concerned with precise LBS, defined here as those applications that require a high degree of accuracy. There are currently a number of enabling technologies that can support precise LBS initiatives. Table 1 gives a brief description and highlights the precision of six enabling technologies and approaches to location determination. These include Global Positioning Systems (GPS), Assisted GPS, time-based methods, wireless Local Area Networks (wLAN), Bluetooth and Radio-Frequency Identification (RFID). The notion of a hierarchical positioning system (HPS) and an integrated network has been put forward by several authors and this paper assumes the ability to pinpoint the location of an end-user by applying a combinative approach [4,5,6,7]. It then follows that this paper is concerned with applications that require a high degree of precision with respect to humans, including navigation, point-of-need information delivery and people tracking.

Table 1 Enabling Technologies for Precise LBS

Techno-logy	Description	Precision
GPS	Satellite-based, global, uses latitude, longitude, altitude. [8]	<=10m
A-GPS	Performs positioning calculations beyond the mobile device.	1m-10m
Time-based	Depends on the time delay of an electromagnetic signal.	50m-150m
wLAN	Cell ID, radio signal strength, location fingerprinting. [9]	1.5m-10m
Blue-tooth	Short-range RF specification.	10cm-10m
RFID	Allows for contactless reading of RF-enabled tags.	1cm-1m

2.1 Objectives

Despite LBS representing an important new application area, there has as yet been little formal, independent consideration of how precise LBS as a whole may affect our world. There currently exists no cogent scenario of a possible future world where humancentric applications of precise LBS have become part of our everyday lives. This paper aims to provide a background to the composition of these plausible scenarios. The objectives include:

1. To identify and describe the current state of development of precise LBS for humancentric applications.

2. To present a way in which the possible future of LBS can be explored.

3. To identify and analyze predictions from credible sources about precise LBS.

4. To discuss the implications drawn from the data collected in objective 2 that point to the future of LBS.

3. Methodology

3.1 Data Collection

The research will use qualitative document analysis (primarily patent applications) and content analysis of current applications of precise LBS. It will also review works that raise social and ethical issues associated with LBS [10,11]. The content analysis will serve as a guided tour of the existing literature and will be descriptive in nature. Such an approach has been chosen because of the complexity of the research question: it demands a qualitative methodology rather than a quantitative one, as this will allow the nuances of the topic to be explored.

3.2 Scenario

The definition of a scenario used in this paper is "[a]n internally consistent view of what the future might turn out to be."[12] Scenarios can be used to combine various separate forecasts that pertain to a single topic.[13] They are designed to provide an overall picture of a possible future, and to describe this future in such a way that it is accessible to a layperson in the subject. Perhaps the value of scenario planning is best expressed by Godet: "[u]nfortunately, there are no statistics for the future... It is, therefore, necessary to gather other people's opinions before forming one's own..."[14] A great part of the reason why a scenario approach has been chosen is that, according to Weber, "new technologies cannot be analyzed in isolation from their social context."[15] A scenario will allow the possible societal impacts of precise LBS to be explored. This paper aims to create a scenario that fulfils Godet's requirements that a scenario "must simultaneously be pertinent, coherent, plausible, important and transparent".[14] The scenario developed will be both exploratory and anticipatory in nature: exploratory in that it will draw on present developments to describe a likely future, and anticipatory because it will be built upon visions of the future predicted by other researchers.

3.3 Scenario Planning

The actual methodology used to develop the scenario is known as scenario planning, using the first three steps of TAIDA as a framework to give structure to the process. TAIDA actually involves five steps, but the last two (deciding and acting) are beyond the scope of this research project. The first three steps of TAIDA are:

1. Tracking: identifying aspects of the current situation and surroundings that may have an impact on the future under consideration

2. Analyzing: considering the possible future consequences of the aspects identified in the first stage

3. Imaging: approaching possible changes intuitively to create a plausible future, "to create not only an intellectual understanding but also an emotional meaning".[16]

3.4 Data Analysis

Analysis of the future scenario presented will be conducted using deconstruction to draw out the social implications. Deconstruction is an approach to literary analysis that aims "to create an interpretation of the

setting or some feature of it to allow people… to have a deeper understanding".[17] The object is to draw out the meaning of the text through interpretation.[18]

Deconstruction as an analytical tool is usually used to expose the ideological limits of the author by examining what is said, what is omitted, and how dichotomies are used to present a particular viewpoint.[17] However, in this case, these techniques will be used to look at the underlying issues presented through the narrative. The methodology will be implemented by looking at events in the scenario and considering the issues that underpin those events.

Hermeneutical analysis was considered as a way of analyzing the scenario, but if this methodology were used there would be too much emphasis on grammatical and technical interpretation rather than on drawing out the underlying issues. Deconstruction is focused on what has happened rather than how the outcome has occurred.[17] Hermeneutical analysis would be more concerned with exposing by what literary techniques certain events or views are constructed, and with giving a "complete understanding of the author's personal style".[19] This is not the focus of the analysis- the aim is to look at the social and ethical issues that are presented. For this, deconstruction is a more appropriate methodology.

3.5 Justification

The Roman philosopher Seneca said: "[t]here is no favorable wind for the man who knows not where he is going."[14] It is often said that the changes LBS bring about will be dramatic, with some even going so far as to say that "this technological revolution will directly or indirectly affect in a significant way practically every person in the industrialized world."[20] Precise LBS is expected to create a paradigm shift in the way we live.

There is certainly merit in exploring the potential effects of LBS before they occur. "[T]oday's process of transition allows us to perceive what we are losing and what we are gaining; this perception will become impossible the moment we fully embrace and feel fully at home in the new technologies."[21] It is also important for analysis of possible future implications to keep pace with technological development. As Michael and Michael highlight: "[m]ost alarming is the rate of change in technological capabilities without a commensurate and involved response from an informed community on what these changes actually "mean" in real and applied terms, not only for the present but also for the future."[22]

4. Enabling Technologies

At present GPS, wLAN, and RFID are three existing technologies best able to support precise LBS. This section discusses these enabling technologies in more detail to show that the development of LBS is supported by a working technological foundation. The discussion is deliberately focused on the technologies' relation to LBS rather than on technical aspects.

4.1 GPS, wLAN, and RFID

Krikelis writes that location sensors to enable LBS "should work inside and outside buildings, ideally anywhere on earth. The information they provide should include orientation and position, with the desired accuracy."[23] Unfortunately, there is no single technology existing today that fulfils these requirements. For now ubiquitous LBS will have to depend on a combination of different technologies. GPS, wLAN, and RFID were earlier identified as being the most appropriate technologies to support precise LBS, because GPS can be very accurate (10 meters or better). However, due to the construction materials used in buildings, GPS does not work indoors or in highly built-up areas.[24] In such places wLAN and RFID are perfectly suited as a replacement positioning technology. In the case of the IEEE 802.11 wLAN, the radio signal strength can be used to perform location fingerprinting,[9] and in an RFID environment scanners can be mounted on walls and in doorways, and positioning is extremely accurate (between a few centimeters and one meter).[1] Further to using RFID for indoor positioning, Martin suggests combining the advantages of the technology with the "containment control" of infrared (IR) transmissions to more accurately locate RFID tags.[25] In his WatchIt system, rooms and hallways are fitted with infrared transmitters, each of which emits a unique code. A person wears a tag that contains both an infrared receiver and an RF transmitter. As they move from room to room, their tag receives the location code of the nearest IR transmitter and combines it with its own unique identification code, transmitting both to local area RF receivers which then relay the codes to a central monitor.[25] But additional costs are associated with the latter measures which can be forgone in a wLAN context. The main point is that no one technology perfectly fulfils all the needs of ubiquitous LBS. However, this does not preclude LBS from becoming widespread. Until a single technology can provide accurate location information both indoors and

outdoors, precise LBS will probably rely on a combination of technologies.

4.2 Standards

For LBS to be effective, there will need to be standards for their operation. Lopez emphasizes the need for LBS to be interoperable and automatic.[26] He states that customers want to be able to focus on informed decision making, which means that LBS need to take care of integrating and filtering information from a variety of sources according to the customer's preferences. This will require common standards for LBS. As a subset of mobile commerce (m-commerce), LBS are partially enabled by m-commerce protocols as they may use Internet technologies for service delivery.

Table 2- Types of LBS

LBS	Description
Geocoding	Determines the latitude and longitude of an address, used directly or indirectly by all other LBS
Reverse geocoding	Uses latitude and longitude coordinates to return other information (e.g. street intersections)
Routing	Delivers step-by-step navigation instructions based on a given starting point and destination
Mapping	Shows a rendered map on the screen of a capable device
Find nearest	Returns nearby geographic features based on a given location
Real-time traffic	Traffic reports (e.g. areas of congestion)
Directory services	Identifies a business or businesses within a specified geographical region

Source: Adapted from Lopez [26]

Lei et al. identify the two most popular as Wireless Application Protocol (WAP), an open, global specification; and i-mode, a proprietary standard developed by NTT DoCoMo.[27] Of these two protocols, Lei et al. are of the opinion that i-mode will play a more dominant role in m-commerce applications and support this with a comparison of the two protocols. LBS will also need a common operating platform on which to run. An existing specification discussed by Lopez [26] that could possibly become a standard is the Open Location Services (OpenLS) interface specification developed by the OpenGIS Consortium.[28] Table 2 identifies the types of LBS that the platform can support.

Some protocols for LBS already exist. It is simply a matter of which one will become the de facto standard.

4.3 Market Potential

With regard to LBS becoming commonplace, Samuelsson and Dholakia have some significant points to make about the market potential of mobile business (m-business) services like LBS. They illustrate several LBS concepts that "will become available to business and consumer users in the years ahead".[29] These examples include an electronic payment application and an advertising-type application that uses customer location data. Samuelsson and Dholakia say that although it may take some time for sustainable business models and the like to evolve, eventually m-business "will become as pervasive as e-business has become today."[29] Their article confirms that LBS will be an integral part of our future world. This opinion is supported by Raisinghani [30] and Lei et al., [27] who agree that it is only a matter of time before LBS become part of the way we live.

5. Existing Precise LBS Applications

Precise LBS are still emerging as an application area but there are some pioneering service offerings that exist today. Some of these will be discussed below, with each example being placed in one of three categories according to the main functionality- tagging, tracking, or tracing.

5.1 Tagging

This category includes all applications where the major objective is some form of information delivery. The name is derived from the "tagging" of a location (i.e. the definition and storage of a coordinate point or bounded area) in order to provide a LBS application when a user approaches or enters that location.

With regard to logistical problems, their resolution may not be far off. Munson and Gupta describe their prototype for a general-purpose notification service that will have three crucial capabilities: to precisely locate subscribers, to precisely define notification areas, and to promptly detect when a subscriber enters a notification area.[31] While it must be noted that the authors' definition of "precise" is broader than the one used in this paper, their work demonstrates that tagging-LBS will be technically feasible. They even state that the system "can also be extended to use the precise location ability in the automobile navigation systems now becoming popular."[31]

If technological issues can be resolved, there will be no shortage of applications in this area. Lucent Technologies has already patented a system that uses wireless telecommunications in combination with knowledge of the user's location in order to automatically perform desired functions.[32] The user's location is compared to that of a remote location such as the person's home or office. As the user approaches the stored location, the network may use this information to initiate particular actions, such as automatically opening the garage door when the user gets within a certain distance of home. In another patent by the same company, the system relies on the user's proximity to a fixed point to deliver tailored information rather than to perform actions. The user's location is compared to the stored coordinates of a remote location. Based on the user's current location and instructions/preferences stored about the wireless device, tailored information is delivered to the user.[32] One application of this might be the user receiving personalized flight information as they approach the airport. There is also an existing patent for a system that alerts the user to the imminent arrival of a vehicle.[33] In this case, the definition of "vehicle" includes a pedestrian. The system depends on "activation points", which are fixed, and could be RFID sensors. Other patented inventions enable the user to save information about a location. One, assigned to Motorola, allows the user to mark a location and attach additional information to it, like text or images. The real novelty of this invention lies in the ability to edit and share the location and the attached information, even showing the location on a map.[34]

5.2 Tracking

This section contains LBS that are focused on locating and monitoring others. Although this research is limited to humancentric applications of LBS, personal vehicle-tracking services are deemed to be humancentric because they allow the person driving the vehicle to be located. OnStar is a United States-based company that offers "invaluable safety and security services created to help protect you and your family while on the road."[35] The system they provide equips vehicles with a GPS device, allowing them to be located by company employees. Customers can request various LBS at the touch of a button, including driving directions, roadside assistance and emergency services. It is not just vehicles that can be tracked, but also individuals on foot. For example, LocatioNet owns a patent that describes a system enabling a mobile user to locate another mobile user.[36] Each mobile device transmits its location to a service provider, which maintains a database of all subscribers. A user can send a message or announcement to others that is stamped with the sender's location. In addition, one user may request the location of another user, with the location of the requested user being shown on a map relative to the position of the requester.

There are also human tracking systems that actually exist as commercially available services. The Wherify Personal Locator is a watch-like device that uses a combination of GPS and network triangulation to track the wearer,[37] and is aimed at parents who want to keep track of their children. When a report is requested, the watch device reports its location to Wherify's servers. The parent can then log on to Wherify's secure website to see their child's location displayed on a street map or even a satellite image.[38] The applications of such tracking systems are certainly not limited to concerned parents keeping tabs on their children. LBS are also being used in Britain,[10] the U.S. and even Australia to monitor convicted criminals. For example, the NSW State Government has announced that the Parole Board will now be able to order convicted sex offenders to wear GPS tracking devices and carry locator units the size of a large mobile phone.[39] An alarm is triggered if the offender attempts to remove the device they wear.[40]

5.3 Tracing

This category covers examples of LBS where the main purpose is to provide navigational information, allowing the user to trace a route on a map to an end point. There are many companies that offer tracing services. One of these is Pharos,[41] which provides tracing-LBS based on GPS and Windows mobile devices such as personal digital assistants (PDAs). As well as displaying a map of the user's location, Pharos's system provides multiple-stop routing and directions. It even shows real-time traffic data for metropolitan areas and takes this into account when planning a route for the user.[42] Until recently there have been no tracing services that work with mobile phone handsets rather than requiring a larger device such as a PDA, but this has now changed. Lopez [26] describes J-Navi, an existing LBS that uses a graphics-enabled handset to display the results of location-based queries on a color map. It uses NTT DoCoMo's i-mode protocol described above. J-Navi is "the world's first operational graphical map delivery to mobile phones."[26] This shows that LBS are already entering the mainstream in places like Japan. Tracing LBS

techniques have even been put forward as a form of knowing where illegal immigrants and refugees are located, and as a way of mapping human virus outbreaks (such as SARS) from their beginning to end [5].

6. Current Research on the Future of LBS

6.1 Societal Implications

Despite existing applications and the research saying that LBS will rapidly become pervasive, there has been little consideration of what implications this will have for society. O'Connor and Godar suggest that the reason for this is that LBS are still in their infancy.[43] However, there is merit in examining how LBS will change our world, and discussing the effects they may have on our everyday lives. There are a number of concerns that arise when individuals, business and government have the ability to precisely determine a person's location. Raisinghani argues that LBS brought with it certain "issues that still need to be addressed and have been downplayed by current technology developers."[30] The major issue is privacy. All three of the application areas described above- tagging, tracking and tracing- rely on determining the user's location. Therefore, even LBS that are focused on tracing and tagging have some element of tracking.

Michael and Michael's article about the human electrophorus makes some salient points about possible future applications of the LBS enabling technologies of RFID and GPS.[22,44] Although the focus of the article is on human implantation of auto-ID devices, it has an important bearing on the ethical implications of any technology that enables the tracking and monitoring of people. It also serves as a measured argument for caution rather than blind acceptance of technology-push- the authors' main message is one of prudence. The authors highlight the need for consideration of the possible future implications of any technology, and this includes LBS.

Similarly, an article by Weckert about trust and workplace surveillance does not discuss LBS specifically, but it does mention electronic surveillance and has some bearing on the potential implications of the widespread use of LBS.[45] Weckert cites Perolle as saying that "surveillance is practiced where trust is low, and… this surveillance [in] itself creates a low-trust workplace".[45] This has important ramifications for LBS in the context of workplace monitoring. LBS allow employers to extend surveillance to employee's activities outside the office. The danger of this

increased employee monitoring enabled by LBS is that it would probably erode trust in the workplace even more, perhaps even extending this erosion to other contexts. A well-functioning and happy community largely depends on a high level of trust, because trust is integrated with notions of self-respect and respect for others.[45] What happens to trust in the community when there is little trust at work, where many people spend a majority of their time?

Another important paper directly related to monitoring and the possible social implications of LBS is that by Williams, Jones and Fleuriot,[46] who investigate the potential impact of mobile wearable technologies on children. It is pointed out that the increased dangers of city living in modern times have largely curtailed children's freedom in urban areas, and the article is focused on how such new technologies might be applied to allow children to make more use of urban spaces. Their paper is based on a research workshop they conducted with 10 schoolchildren between the ages of 11 and 12. Though this is a small sample group, it was appropriate to the aims of the workshop. Focus sessions with the children were also conducted to determine their views of the new technologies. Both the researchers and the participants concentrated on the LBS potential of the technologies they were investigating. Some of the children's comments from the article are as follows: "[T]he map is good because then people can see where you are…| [Y]our parents might want to have it to check you are safe.| [Researcher] Would you like that?| Yes, because then you would be able to go out more…| [Researcher] What would they use it for?| They'd use it to check up on you."[46]

A highly similar study was conducted very recently by the same researchers. In this study, they worked with 36 children aged between 9 and 10.[47] The attitudes of these children were very similar to those in the first study. One child said: "[I]t could be like a new way of keeping up with your children. You could have like a tracking device on it and you could load it in to a PC… so like your parents could track their children to make sure they don't go anywhere."[47]

These two studies are rare in that they focus on the possible societal implications of LBS technology. They also go some way toward showing that children, at least of this age, would probably accept and perhaps even welcome the possibility of tracking-LBS. The studies do have some failings in that they are not really large enough to properly gauge the reaction of the majority of children in the general populace, and the results obviously cannot be extrapolated to other age groups. The authors do provide an excellent discussion of the

societal implications arising from the studies, though these are limited by the studies' focus on children's use of urban space.

6.2 Ethical Dilemmas

The article 'Geoslavery' by Dobson and Fisher is also highly relevant to this research.[10] The authors (both "long-term insiders of the GIS community") describe several ways in which LBS could be used to subjugate individuals and exert real-time control. They say that three technologies- GPS, GIS and miniature radio transmitters- can be combined to enable an electronic form of 'geoslavery' (the coercive monitoring and exertion of control over the physical location of a human being). A GPS receiver tracks the person's location and the radio transmitter sends the information to another person, who uses a GIS to relate the person's movements to streets and buildings. Dobson and Fisher identify four different types of spatial constraints: prescribing a path that must be followed, allowing free reign except for off-limits areas, limiting movement to specific places at specific times, and barring intersections between a person's path and that of another person or persons.[10] All of these could be aspects of geoslavery. A major point that the authors make is the danger of LBS inaccuracies implicating people unfairly, with potentially extreme results. They give the example of so-called 'honor killings' in some cultures where a male family member may kill a female who has 'disgraced' the family, such as by visiting a man alone or even by seeing a movie without permission. In this case, a woman could be murdered simply for standing in the wrong place. A slight inaccuracy in reported location could mean the difference between appearing to be inside or outside a man's house.

The article is definitely biased toward presenting a negative view of potential LBS applications, but as the authors point out: "benefits get more than their due from commercial advertising, while hazards are ignored by vendors and, all too often, by public officials as well."[10] The authors are right. LBS technology vendors and service providers give more than enough attention to the positive aspects of LBS. It is fair for them to present a different perspective in order to redress the balance. They do remind the reader that it is not technology itself that is either good or evil, but the uses to which human beings put it. They also support their claims (elevating them above mere wild imagination) by showing that enabling technology for geoslavery already exists. In fact, not only does the technology exist, it is already being used for some of

the purposes that Dobson and Fisher postulate in several countries. Fortunately, this has not occurred entirely without public debate. For example, the NSW State Government states that the use of LBS for paroled sex offenders is supposed to be "an extra protection for potential victims and… one way of making parole conditions more effective", but there are others voicing fear that it will lead to parole being granted to more serial sex criminals.[39] Some are concerned about it being a detriment to rehabilitation, stigmatizing people who are trying to become productive members of the community again.[40] This sort of debate is reassuring: it shows that society in general is not apathetic to LBS and the possible effects it may have.

6.3 The Legal Ramifications

It must also be remembered that LBS is not just used to monitor convicted criminals that have voided some of their rights to freedom by breaking the law- innocent individuals may also be monitored and controlled. Parents can use commercially available services (such as those described in the Tracking section above) to monitor their children. In the U.S. at least, the use of LBS surveillance for children would be unlikely to be contested successfully. Parents are given a great deal of control over their children, because of "the peculiar vulnerability of children; their inability to make critical decisions in an informed, mature manner; and the importance of the parental role in child rearing."[48] The findings of Williams et al. in their discussions with children also suggest that many children would not particularly mind being monitored via LBS, and may even welcome it. However, we may not know the impacts of the widespread monitoring of children until they actually occur. Perhaps Weckert's ideas about the need for trust in a community would hold true. There is certainly no need to bother with 'outdated concepts' like trust when you can actually see exactly where someone is at any given time.

Even if the monitoring of children is neither socially nor legally problematic, some people may use LBS for other surveillance purposes, such as tracking aging relatives with Alzheimer's to 'ensure their safety'. Batty presents the example of elderly patients in nursing homes, saying that a LBS system could raise an alarm if the "subject" wanders outside specific areas.[49] He even goes so far as to suggest monitoring their physical activity levels to make sure they get adequate exercise. But who decides when a person is sufficiently impaired to warrant making them wear a tracking device? There are no specific laws relating to

LBS that could guide such decisions.[50] The real-life uses of LBS for control purposes today highlight the need to develop concrete guidelines for LBS applications. Some thought has occurred in this area, such as Durocher's 'Laws of LBS', inspired by Isaac Asimov's 'Three Laws of Robotics'.[51] Durocher's proposed laws are as follows:

"First LBS Law: Location, through its availability or non-availability, must not allow a human being to come to harm.

Second LBS Law: The availability of one's location must be in one's complete control, except where such control would conflict with the First Law.

Third LBS Law: The providers of location-based services must be allowed to create a profitable business from these services as long as such business does not conflict with the First or Second Law."

Of course, while useful for guiding discussion about the social and ethical issues involved in LBS, these 'laws' will probably be useless unless they are backed up by legally enforceable regulations. Even then, they would likely only be applicable during peacetime. Sui suggests that this would particularly be the case in the context of ongoing conflicts like the "war on terrorism".[50] This is backed up by a survey conducted by Boondao, Esichaikul and Tripathi where more than two-thirds of the respondents cited safety and security issues as the main reasons for wanting widespread LBS.[52] As such, the main value of these 'laws' lies in provoking thought and debate about the widespread use of LBS rather than actually enforcing compliance.

7. A Future Plausible Scenario

While there have been some scenarios developed about the future of LBS, these tend to be limited in scope and related discussion is lacking. Samuelsson and Dholakia provide a scenario depicting how LBS could enable a mobile office solution, and also give several examples of how LBS could be used in different application areas.[29] These, however, are fairly brief and are certainly not accompanied by any kind of discussion about what societal effects such services may have.

Dobson and Fisher also present different ways in which LBS could be used. However, they focus on uses for geoslavery, such as the following: "[I]t is quite possible for an abusive husband, for example, to purchase an inexpensive devise [sic] or service that will enable him to follow his wife's every step, monitor her daily travels, report her whereabouts, identify whether she visits a specified friend, and time her stay on any

given visit."[10] Again, the authors' scenarios are brief, presenting small snippets of potential real-life examples of how LBS might be used. The difference is that Dobson and Fisher's scenarios are accompanied by relevant discussion of the social and ethical issues involved.

Another notable LBS-related scenario is MIT's Project Oxygen. Oxygen is MIT's vision of a system that is freely available, everywhere, all the time- just like the oxygen in the air we breathe.[53] One of the important themes of Oxygen's technologies is described as "distribution and mobility", and users of the system carry multifunction handheld devices that, among other things, act as GPS receivers. These qualities of the system allow for applications of LBS. Several scenarios are presented based on potential uses of the Oxygen system. One describes the system facilitating a business conference, while another illustrates how it could act as a "guardian angel" to the elderly. Yet another shows various uses of Oxygen on a students' field trip.[53]

7.1 Next Steps

Many of the works discussed above are largely academic in nature, especially those considering standards, market potential and social and ethical issues. These are high-quality sources. The patents mentioned are also important and are based on solid research and development. Although the websites sourced are generally commercial and certainly should not be relied upon as the sole basis of research, they are useful for demonstrating the types of LBS that exist today. The real value commercial websites, combined with the credibility of both academic papers and patents, is that they offer a convincing foundation for the opinion that LBS will be a pervasive part of our future world.

Given that the use LBS is likely to increase dramatically, perhaps it is not surprising that there are quite a few sources that discuss the possible social implications that may arise. Sui points out that consideration of social issues is especially urgent for LBS because of their potential ubiquity and close coupling with users' personal lives.[50] The studies conducted by Williams et al. are pioneering in this respect- they investigate and discuss possible future uses of LBS by children and how they will affect daily life.[46,47] Other articles that have been mentioned here, particularly Dobson and Fisher's, are also concerned with potential social implications.[10]

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8. Conclusion

What is noticeably lacking in the literature is a scenario that depicts a coherent vision for LBS and is accompanied by a discussion of the issues underpinning it. The scenarios that do exist are usually limited in scope and present a utopian view of how LBS will change our lives. MIT's *Project Oxygen* is especially guilty of this last failing. Although it was the most comprehensive scenario found, it is biased toward presenting only the beneficial aspects of LBS. Like any new technology, however, LBS are likely to have both positive and negative effects. There is a need for a realistic, cogent scenario depicting how LBS may change our world in the future. There is also a need for a rational discussion of the possible societal implications that may arise.

It is vitally important to consider how the widespread use of LBS may affect society and to provoke debate about where we are headed. With LBS already being used to monitor criminals and children today, it is really only a matter of time before LBS surveillance extends beyond these groups. No laws have been written to deal with the possible uses of LBS. Surely, on the brink of a future where LBS are ubiquitous, there is a need to look at plausible destinations of our current path.

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