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Developing location-based mobile advertising in Singapore: A socio-technical perspective

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ABSTRACT

Increasing adoption of location-based services and smartphones leads to optimistic forecasts for location-based mobile advertising (LBA).This study investigates the development of emerging LBA in Singapore by examining stakeholders' perspectives and shaping forces in the socio-technical subsystems (i.e., technology, market/industry, and government/regulation). In addition to document analysis, it conducts in-depth interviews with key industry players in the LBA value chain, policy-makers, and smartphone consumers in order to identify drivers and challenges in this nascent mobile business. The socio-technical analyses show that LBA in Singapore is technology-ready with government support and industry pull, while conservative advertisers, negative consumer attitudes, and insufficient regulations hinder LBA's diffusion. The results reveal that LBA at an early adopter stage in Singapore has a relatively convergent and competitive value chain, as telcos play a crucial part in creating and distributing LBA services. With a newly launched Personal Data Protection Act, smartphone consumers still show concerns about personal privacy, data security, and intrusive spam. Technical implementation and LBA effectiveness are major inhibitors for advertisers' adoption. The Singapore case offers market and regulatory implications for other mobile-advanced countries to develop mobile marketing, location-based services, and LBA.

1. Introduction

Advancements in mobile devices (e.g., smartphones and tablets) integrated with global positioning technology have paved the way for emerging location-based services (LBS). By integrating mobile advertising with LBS, location-based mobile advertising (LBA) enables the delivery of marketer-controlled information customized for users' geographic positions delivered to their mobile devices (Brunner & Kumar, 2007). Compared with traditional advertising, LBA presents an innovative channel that enables advertisers to deliver unique offers (e.g., promotions, vouchers, and coupons) that can be customized based on consumers' preferences and geographic location (Xu et al., 2009). With the increasing adoption of ubiquitous mobile devices capable of wireless Internet connectivity and location awareness, LBA creates opportunities for targeted marketing and revenue generation (Dhar & Varshney, 2011).

Recent industry reports suggest optimistic forecasts for the fledging LBA industry. Analyst firm Pyramid Research projected global LBA revenues to reach US$6.2 billion by 2015 and comprise 35% of mobile advertising revenue and 60% of LBS revenue (PR Newswire, 2011). On the other hand, Berg Insight estimates that the LBA market will grow to US$6.5 billion by 2016 (Cett, 2012) while Global Industry Analysts forecasts US$12.8 billion growth by 2017 (PR Web, 2011). Although the US and Europe currently dominate the global LBA market (PR

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Web, 2011), the Asia-Pacific region is expected to take the lead by 2016 (Cett, 2012). Countries such as Japan and South Korea are currently leading the Asian LBA market since location-based services have been offered there by telcos for several years (PR Newswire, 2011; Mobile Marketing Association (MMA), 2011).

Despite the fast growth of LBA, little scholarly attention has been given to examine its drivers and challenges especially in the Asian context. Previous studies mostly comprise of attempts to explore mobile advertising at the micro level with emphasis on consumer perceptions (Xu et al., 2009; Banerjee & Dholakia, 2008; Liu et al., 2012; Unni & Harmon, 2007), attitudes (Brunner & Kumar, 2007; Lohan et al., 2011), and adoption (Zolfaghar et al., 2010). To our knowledge, no work has yet to provide a macro-level socio-technical analysis of the development of LBA subsystems. It is holistic and insightful to examine the development of emerging mobile technology like LBA using a socio-technical framework as this approach can analyze the shaping power and complex interrelationships among actors in technology, market/industry, and policy/government sub-systems and LBA's technological trajectory in a social system (Allen, 2003; Lin, 2012a; Shin, 2010).

In the Asian context, Singapore has a mobile penetration rate of 148.2% with more than 7.8 million 3G and 4G mobile subscriptions as of November 2014, according to the country's Infocomm Development Authority (IDA) (Infocomm Development Authority, Singapore (IDA), 2015). In a Nielsen 2013 survey, Singapore has the highest smartphone ownership in Asia (Magdrilla, 2013). Singapore's high mobile phone penetration and well-regulated media environment can benefit the future development of mobile advertising (Wei et al., 2010). Singapore's mobile advertising market grew by 30% in 2011 (InMobi, 2012) and ranked 15th globally in terms of mobile advertising impressions (Opera, 2012). It has a vibrant LBS market with a number of startup app developers and avid mobile consumers (Lau, 2012). Seeing Singapore's potential as a test bed for LBA development, the Location Based Marketing Association (LBMA) made Singapore its regional hub in Asia in November 2012 (Lau, 2012; Lee, 2012).

Using a socio-technical framework as an analytical lens, this exploratory study examines LBA's technology, market/industry, and government/policy subsystems in Singapore. This study, which conducts document analysis and interviews with stakeholders, aims to provide insights to drivers and challenges of LBA in Singapore. The findings can enhance the understanding of LBA's socio-technical subsystems, identify key developmental issues, and analyze its future trajectory. This study also makes recommendations to improve LBA policy development and LBA's market/industry competiveness.

This article is divided into seven sections. The next section reviews literature on the socio-technical framework and explains its application to emerging technologies. After Section 3 illustrates the methodology, Section 4 presents an overview of LBA's technology, market/industry and policy subsystems by sorting out abundant information in prior studies and market reports globally. Section 5, which analyzes the results of stakeholder interviews and document analysis, explicates LBA's socio-technical subsystems in Singapore. Section 6 provides a holistic socio-technical analysis of LBA's drivers and challenges in Singapore, and makes recommendations for other countries. Finally, Section 7 concludes with a summary and lists contributions and future research directions.

2. Socio-technical analytical framework

Technological innovations have been evaluated only with its technical aspect focusing on systems and applications (Shin, 2010). According to Shin (Shin, 2012), such a traditional view is short-sighted since social factors need to be considered in addition to the technical core of emerging technologies. Moreover, technological artefacts are greatly influenced by technical, political, social, and economic factors (Lin, 2012a). Realizing the important role of social factors, there is a need to highlight the interaction of consumers, industries, and the government in relation to the technology.

Past studies have shown that this analytic framework is helpful in understanding complex interrelationships between technological and social systems shaping the development of emerging mobile technologies (Lin, 2012a,b; Shin, 2010; Hsu et al., 2008; Sawyer et al., 2003; Han, 2003; Lin & Liu, 2011). Sawyer, Allen, and Lee (Sawyer et al., 2003) predicted the course of emerging broadband and mobile opportunities through the lens of a socio-technical approach by examining the technological and social forces (regulation/government/market/users). Similarly, Shin (Shin, 2010) evaluated South Korea's cyber-infrastructure by investigating complex interactions of its social and technical aspects. To analyze adoption of broadband technologies in South Korea, Han (Han, 2003) concluded that the information and communications technology (ICT) policy was the main driving force among the technology, policy, and culture systems. Lin and Liu (Lin & Liu, 2011) applied the socio-technical framework in examining mobile broadcasting TV in Singapore and Taiwan and found industry pull as the driving force but policy postponed the deployment of technology-ready mobile services. Lin's (Lin, 2012a) socio-technical analysis of mobile TV study in China argued that the rollout of government/policy driven mobile media was delayed by regulators' competition, multiple technological standards, and weak market receptiveness. These studies support the view that a socio-technical approach which analyzes multi-directional shaping power from various actors is suitable for examining how subsystems shape the trajectory of emerging technology at different stages and contexts (Lin, 2012a,b; Shin, 2010; Hsu et al., 2008; Sawyer et al., 2003; Han, 2003; Lin & Liu, 2011).

As the LBA industry in Singapore is nascent and evolving, a socio-technical analytical framework is appropriate for investigating and analyzing its developmental trajectory. In order to identify the drivers and challenges, this study identified stakeholders in the technology, market/industry, and government/policy subsystems and analyzed their perspectives and interests so as to understand their shaping power of LBA's trajectory. Stakeholder analysis, which has been applied to mobile management (Shin, 2008) and broadband diffusion (Sawyer et al., 2003), is the process of identifying key actors who are likely to have impact on the development of emerging technologies (Shin, 2012). The analysis will illuminate discrepant views, power struggles, and potential strategies. According to Shin (Shin, 2012), a stakeholder analysis: 1) identifies stakeholders, 2) determines their claims, 3) decides resources provided by stakeholders and their influence, and 4) analyzes stakeholder attributes of power, legitimacy, and interests. Within the socio-technical framework, this study analyzes dynamic and critical relationships among stakeholders.

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3. Methodology

This study used a mixed method (i.e., document analysis and in-depth interviews) to identify stakeholders' shaping powers in LBA's socio-technical subsystems and analyze the drivers and challenges of LBA development in Singapore. The socio-technical framework was used to guide our data collection and data analysis in order to examine how the three subsystems (e.g., technology, market/industry, and government/policy) shape the developmental trajectory of LBA in Singapore. First, we thoroughly searched LBA-related secondary data from abundant archival materials (e.g., news reports, academic journals, white papers, government reports, and policy papers). They provided useful insight about LBA types, technology, market development (e.g., value chain and customer responses), and policies as well as global trends and obstacles. They were helpful in identifying key players in Singapore's LBA industry and understand local LBA environment.

To conduct in-depth interviews with stakeholders, we identified key actors in Singapore's LBA value chain (i.e., telcos, application developers, advertisers, advertising agencies/networks and policy-makers) and invited representatives from identified organizations for in-depth interviews. From November 2012 to February 2013, we conducted a total of 11 expert interviews (10 face-to-face interviews and one e-mail interview) with organizations that play a critical role in the local LBA landscape (see Appendix A – Table A-1). For the semi-structured interviews, we mainly asked questions from a systematic interview guide and raised queries when interesting or critical information emerged during conversations. Industry interviewees were asked questions about LBA business use and experiences, business models and strategies, LBA effectiveness, consumer responses, and forecasts. For the policy-maker interviews, the questions mainly dealt with LBA regulations such as privacy concerns and data protection policies. The interviews were mostly conducted in the offices of the interviewees. Interviews lasted for 31.5 minutes on average and were recorded for transcription.

To analyze the development of emerging LBAs, it is important to investigate consumers' perspectives that shape the market/industry subsystem. Between March to April 2013, this study used purposive sampling to recruit 25- to 40-year-old smartphone users because this age group exhibits the highest smartphone ownership (92%) in Singapore (Blackbox Research, 2012). With an average age of 32, 83% of the 30 interviewees are well-educated working adults (Appendix A – Table A-2). Majority of the interviewees are Chinese. They fit the profiles of LBA's early adopters who can shape initial technological diffusion in Singapore. In terms of LBA use, majority (60%) are non-adopters, followed by adopters (26.7%) and previous adopters (13.3%).

We used a semi-structured interview approach to ask respondents questions from the interview guide that was constructed based on insights from secondary data and industry interviews. The main questions are related to consumers' perceptions and experiences about LBA (i.e., perceived benefits and drawbacks, concerns, interesting content, adoption, and future use). All interviews were recorded and later transcribed for thematic analysis. By triangulating multiple sources of data from expert and consumer interviews and archival materials, the findings of this study can demonstrate increased reliability and validity (Shin, 2012) for the socio-technical analysis of stakeholders' shaping power in Singapore's LBA industry. In the analysis, industry players and individual consumers were not identified as they requested anonymity.

4. Overview of location-based mobile advertising

The emergence of mobile devices and advancements in location technologies such as GPS has brought innovative and targeted use of LBAs (Banerjee & Dholakia, 2008). Advertisers are now able to present advertisements with location-specific information on consumers' mobile devices (e.g., mobile phones and tablets) in certain areas (Shankar & Balasubramanian, 2009). By utilizing personal, interactive, and ubiquitous characteristics of mobile devices, the effectiveness of advertising campaigns can be improved greatly (Wei et al., 2010). Gartner estimates around 800 million LBS users worldwide by the end of 2012 (Gartner, 2012). The increasing consumer interests in LBS also offer impetus for the development of targeted LBAs (Peterson & Groot, 2009).

According to Unni and Harmon (Unni & Harmon, 2007), LBA is a type of targeted advertising sent by identified sponsors to consumers' mobile devices when they are near specific locations. Brunner II and Kumar (Brunner & Kumar, 2007) define LBA as marketer-controlled mobile information customized for recipients' geographic positions. Recently, the Mobile Marketing Association (MMA) (Mobile Marketing Association (MMA), 2011) defined LBA as any application, service, or campaign that incorporates the use of geographic location to deliver or enhance a marketing message/service. In this study, LBA refers to advertisements containing geo-specific information that are sent to mobile device users near advertised vendors in the form of mobile applications, Short Messaging Service (SMS), or Multimedia Messaging Service (MMS).

4.1. Technology

With the rise of smartphone adoption across the globe, location-based mobile applications (e.g., Foursquare, Shopkick, Yelp, and Gowalla) provide alternative advertising tools to interact with consumers in addition to SMS and MMS. LBA content is usually made by advertisers or their respective agencies on a LBA campaign management platform which enables the creation of advertising content and designation of reception areas. Geofencing allows advertisers to recognize mobile users within a predetermined radius around the advertiser's vicinity (Mattioli & Bustillo, 2012; Tode, 2012). When the mobile device enters the geofenced area, the location information detected by positioning technologies (GPS, Cell-ID, and A-GPS) will be sent to the LBA database server through cellular or wireless networks. After the LBA database server receives and analyzes the location information, it will transmit appropriate LBA messages or alerts back to the targeted mobile device. With improvements in existing 3G services and rollout of 4G networks, higher transmission speeds can support complex LBA applications to provide personalized and contextual content to consumers (Xu et al., 2009). Currently, there are some technological limitations which may hamper the adoption of LBA. For example, the inaccuracy of location positioning,

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especially indoors, have to be improved (Dhar & Varshney, 2011). Wireless coverage and bandwidth are also crucial to ensure users stay connected and enjoy a seamless experience.

4.2. Market/industry

Due to the prevalent use of location-aware mobile devices (e.g., smartphones), the adoption and use of LBAs keep increasing (Mobile Marketing Association (MMA), 2011). According to the 2012 Digital Influence Index (Vogt & Alldredge, 2012), a global survey of 4,612 Internet users reveals that among 80% of smartphone users, half of them use LBAs with special offers and discounts. Results from Placecast's 2013 poll show that 78% of US smartphone users find location-based mobile offers more relevant than traditional marketing incentives (eg., coupon) (Placecast, 2013). JiWire's survey (JiWire, 2011) find that 75% of North American respondents take action after receiving LBA messages by clicking on ads (31%), searching for nearest shops (21%), and conducting product research (21%).

However, Nielsen's 2012 report show that although smartphone ownership in Asia-Pacific keeps soaring and drives increasing use of LBS, advertisers still have difficulty in engaging customers to click on mobile advertisements (Marketing Zeitgeist, 2012). It suggests advertisers build in key hooks such as utilizing contextual information and a targeted approach in order to engage consumers effectively with brands and improve responses.

4.2.1. Value chain

The growing LBS market has prompted players involved in the mobile advertising to use location technologies to enhance relevancy and effectiveness (Cellular News, 2012). The commercial opportunities lead to convergence of the mobile advertising value chain which consists of ad content agencies, ad networks, and publishers as well as the LBS value chain which includes LBS content, technologies and platforms, and applications (Peterson & Groot, 2009). In the nascent LBA value chain, brands and advertisers first decide who to work with to develop LBAs and manage campaigns – traditional advertising agencies, location technologies/platforms (e.g., Navteq and Google Maps), or LBS application developers (e.g., Foursquare, Yelp, and Gowalla). Even after the advertising agencies finish the ad content, the mobile advertising value chain (agencies, mobile ad networks/platforms and publishers) still have to collaborate with location-based technology/platform and LBS application developers to incorporate location-based features and implement the campaigns. Finally, LBAs will be distributed by wireless carriers or mobile operators to targeted mobile devices. After detecting mobile users in geofenced areas, wireless carriers networks will transmit location information to servers and then send selected LBAs to targeted consumers (Dhar & Varshney, 2011; Chen & Hsieh, 2012).

According to Peterson and Groot (Peterson & Groot, 2009), the convergent LBA value chain in the US is fragmented as consumers receive LBAs through various providers and platforms. Players in the existing advertising value chain face new challenges from competition brought by new entrants (e.g., mobile coupon providers, mobile search companies, and proximity marketing providers) (Mattioli & Bustillo, 2012; Cellular News, 2012).

4.2.2. LBA types

Various LBA business models have been developed to leverage on mobile devices' location capabilities to deliver targeted advertisements to consumers. According to the U.K.'s Internet Advertising Bureau (IAB) (Internet Advertising Bureau, UK (IAB), 2012), the three common models include: (1) location-based banner advertising (i.e., a promotional banner displayed within mobile applications), (2) location-based messaging (i.e., SMS or MMS messages sent to consumers within a geofenced area), and (3) location-based mobile applications (i.e., sending offers and promotions by opting-in to location-aware mobile applications such as Foursquare, Yelp, and Gowalla). Based on advertising goals, advertisers can choose a suitable LBA type to provide enhanced mobile advertising experiences to improve customer engagement and brand loyalty (Hopkins & Turner, 2012).

The marketing strategies of using LBA can be classified as a push or pull approach (Brunner & Kumar, 2007). In push-based LBA, advertising content – usually SMS and MMS advertising – is automatically delivered to users based on location or in combination with predefined preferences (Li & Du, 2012). Active push-based LBAs are used for promotion or sales in order to incite impulse purchases (Unni & Harmon, 2007). As studies show push LBAs are likely to be perceived as intrusive as mobile spam if sent without consumer permission (Cleff, 2010; Okazaki & Barwise, 2011), it is recommended that advertisers send push LBAs after obtaining consent. On the contrary, pull-based LBAs are sent when mobile device users initiate their search for advertisings, promotions, or product-related information (Peterson & Groot, 2009). They allow consumers to have greater involvement and engagement (Li & Du, 2012). Pull LBAs can be seen as "on-demand" services which provide consumers with greater control so as to reduce privacy concerns or negative attitudes (Xu et al., 2009).

As the LBA market grows, it is critical for advertisers to evaluate consumer attitudes and responses (Unni & Harmon, 2007). According to Liu et al. (Liu et al., 2012), people tend to view mobile advertising negatively and describe it as unwanted and irritating. Consumers who feel that LBAs invade their privacy usually regard them as unsolicited spam (Dhar & Varshney, 2011). To reduce these negative perceptions, advertisers should seek consumers' prior consent before sending LBAs (Wei et al., 2010). When perceived benefits outweigh its potential risk or sacrifice, consumers will accept potentially invasive technology, like push LBAs (Cleff, 2010). Despite privacy concerns, recent reports show a stable growth of using LBAs because of their relevancy, advantages, and location proximity (Dhar & Varshney, 2011). MMA (Mobile Marketing Association (MMA), 2011) emphasizes the significance ofoffer the choice to opt-in to control individual LBA experiences when consumers reveal increasing interest in receiving this new type of mobile advertising.

4.3. Government/regulation

Since LBA requires personal socio-location data (Li & Du, 2012), consumers have raised concerns about the legitimacy of using private information for commercial or marketing purposes (Okazaki et al., 2012). It is a legislative challenge to maximize economic potential of emerging mobile technologies like LBAs while providing adequate consumer privacy and data

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protection. Previous studies find that regulatory protection of personal data will increase consumer trust and usage of mobile advertising (King & Jessen, 2010), while neglecting consumers' privacy concerns is likely to cause distrust of using location-aware services and jeopardize their future diffusion (Xu et al., 2011). However, emerging technologies like LBAs usually progress at a fast rate when the development of related policies and regulations lag behind (Lin, 2012a; Cleff, 2010). Most countries have not formed specific policies for LBAs.

The European Union (EU) is one of early adopters that developed mobile advertising regulations to protect consumers' privacy personal data in its member states. There are two legislations influencing mobile advertising and LBA practices there. Directive 95/46/EC or the "Data Protection Directive" regulates mobile advertising in the aspects of data and privacy protection and mandates each EU member state to establish an independent national authority which will be responsible for its enforcement (Cleff, 2008). LBA is specifically regulated under Directive 2002/58 or the E-Privacy Directive (Cleff, 2008). This directive prohibits mobile operators from using private or locational data for marketing or value-added services without subscribers' consent (King & Jessen, 2010). The two directives mandate businesses in EU to acquire consent thru the opt-in approach before sending LBAs (Brunner & Kumar, 2007) and give consumers the right to opt-out and unsubscribe from these services (Cleff, 2008).

In the US, the Federal Trade Commission (FTC) and Federal Communications Commission (FCC) govern LBS and LBA (Desai et al., 2011). The FTC takes charge of protecting consumers from unfair and deceptive advertising practices (King & Jessen, 2010) while the FCC oversees mobile operators to ensure them obtain consumers' permission before processing location-based data in order to protect mobile subscribers' privacy and data safety (Desai et al., 2011; Government Accountability Office (GAO), 2012). In the absence of any LBA legislation, the FTC encourages companies to self-regulate by adhering to Fair Information Practice (FIP) principles for protecting privacy information (Gellman, 2013). To protect against spam, the Telephone Consumer Protection Act (TCPA) and the Controlling the Assault of Non-Solicited Pornography and Marketing Act (CAN-SPAM) mandate consumers' opt-in before any forms of mobile advertising are pushed out to them (Brunner & Kumar, 2007).

Although both the EU and the US are concerned about mobile advertising's consumers, the former provides a more comprehensive data protection policy (Cleff, 2008) with a stronger regulatory foundation for consumer privacy and data protection (King & Jessen, 2010). In Asia, regulations for protecting consumer privacy and data against mobile advertising misuse are comparatively less developed since most countries have no or just limited data protection laws (Kennedy et al., 2009). To increase business competitiveness for the growing mobile advertising market, governments in the Asia-Pacific region began to adopt or develop data protection laws by 2011 (Greenleaf, 2012). In December 2011, China released a new regulation which clearly defined obligations and liabilities of Internet Information Service Providers (ISPs) to protect personal information. Chinese authorities thought this would provide personal data protection for the growing targeted advertising's consumers using cloud computing (Kennedy, 2012). In the same year, South Korea promulgated its Personal Information Protection Act for both the public and private sectors but this was criticized by business commentators as the strictest in the world (Greenleaf & Park, 2012). Other countries such as Hong Kong, Taiwan, Thailand, Vietnam, and Singapore are making progress in legislating privacy protection to cope with the delicate balance of international compliance, economic prosperity, and consumer trust in the digital economy (Greenleaf, 2012; Kennedy, 2012).

Based on document analysis, the development of LBA in mobile-advanced countries is technology-ready. The increasing use of smartphone and LBS propels customers' acceptance of LBAs, especially those with a pull approach and opt-in feature. Concerns for personal privacy and data misuse are found as inhibiting factors for using LBAs. Following the footsteps of the EU and the US, Asian countries started to regulate mobile operators and advertising practices in order to safeguard mobile users' privacy and personal data.

5. LBA's socio-technical subsystems in Singapore

In September 2012, Singapore telcos rolled out 4G networks (Huang, 2012). This country has more than 8.4 million mobile subscriptions with 155.6% mobile population penetration rate in 2014 (Infocomm Development Authority, Singapore (IDA), 2015). With the high ownership of smartphones (Magdrilla, 2013), 86% of mobile Internet users in Singapore get connected via 4G and 3G networks (Infocomm Development Authority, Singapore (IDA), 2015). Although Apple's iPhone is the most prevalent in Singapore's market, Android-based mobile devices are getting competitive in market share (Reed, 2013). Singapore smartphone users have the second largest number of regularly used apps in Asia-Pacific (Marketing Zeitgeist, 2012). According to the LBMA's president (personal communication, 10 January 2013), Singapore has great potential to develop LBAs as a regional hub. Aside from mobile technological advancements, Singapore has a large concentration of brands and advertising agencies to serve as the "perfect gateway" to other Asian markets (LBMA's president, personal communication, 10 January 2013).

5.1. Technology subsystem

Based on interview and archive data, this study delineates emerging LBA's technological infrastructure in Singapore which encompasses key technical components, wireless and mobile networks, stakeholders, and LBA production flow (Fig. 1). Singapore's advertisers and advertising agencies create LBAs through campaign management platforms which enable the input of content and promotion types, setting geofencing and schedule campaigns. According to application developer 1 (personal communication, 27 November 2012), finalized LBAs are stored in a database server which usually uses cloud computing to minimize hardware cost. For push-based LBAs, after mobile users enter geofenced areas, their mobile devices will be detected by positioning technologies (e.g., GPS, Cell-ID or WiFi) and this information is sent to the LBA database server to retrieve ad content from the campaign management platform. Later, mobile consumers will receive LBA messages through mobile networks. As for pull-based LBAs, consumers actively search for brand-related information in proximate locations and respond to LBAs' requirements for obtaining

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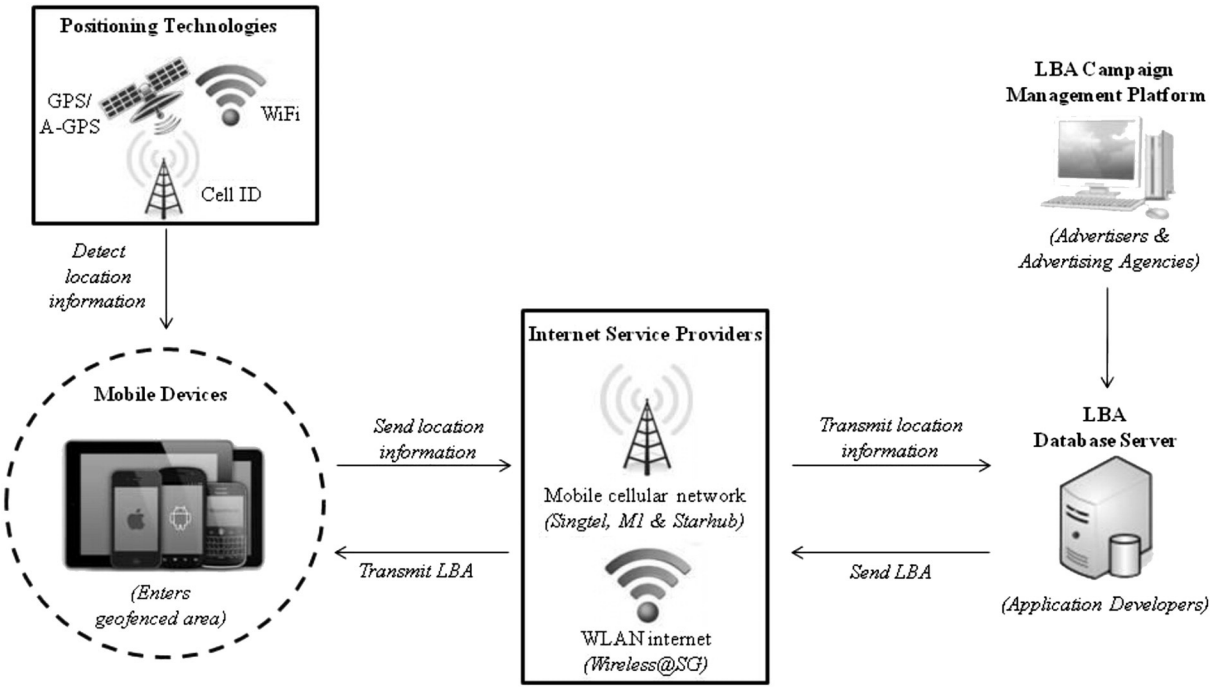

Fig. 1. LBA technological infrastructure in Singapore.

promotion incentives. In Singapore, telcos' (i.e., Singtel, Starhub, and M1) mobile cellular networks (e.g., 3G and 4G) and Wireless LAN (WLAN) (e.g., Wireless@SG, a nationwide free Wi-Fi service) provide the connectivity for disseminating LBAs and location information between mobile devices and database servers. Once the location information is received, the server will select and send LBA content to the designated mobile device.

5.2. Market/industry subsystem

According to MMA (Liau, 2013), Singapore's high level of smartphone adoption and rapidly growing mobile application ecosystem were driving LBA's development. Currently, LBA services are either provided by telcos' advertising divisions or location-based mobile application developers with or without advertising agencies. Two models of LBA are popular for advertisers in Singapore: telcos' push location-based messaging (SMS and MMS), which dominates the mobile advertising market, and primarily pull-based mobile application LBAs that bring new competition to incumbents in the value chain.

Singapore's LBA industry began in November 2007 when MobileOne (M1), one of the three telcos in Singapore, successfully rolled out the first SMS ad (Wei et al., 2010). Later, Starhub launched the same service in April 2008 (StarHub, 2008), followed by Singtel in May 2009 (Singtel, 2009). MMS ads have been provided by the three telcos with a push location-based approach since 2009. Location-based SMS ads, which consume less data size, are used more prevalently than MMS ads in this market.

Foursquare, a foreign LBS application, offered check-in mobile advertising in early 2009 and became the first LBA platform. Soon after, ten home-grown LBA applications were launched with various advertising strategies and appeals. All applications were available for the iOS operating system and some can also be used on Android devices. To stimulate mobile consumers' impulsive responses, the LBA mobile applications utilize four advertising strategies: (1) daily deals promotions (e.g., vouchers), (2) loyalty reward card (e.g., collecting stamps for rewards), (3) check-in promotions (e.g., check-ins for discounts), and (4) local search advertising (e.g., looking for nearest shops). Table 1 shows the eleven LBA applications' various forms of appeal, approaches, operation systems, and background. The majority use pull strategies to provide incentives as hooks. Only three LBA applications (i.e., PromoNearYou, Sprooki, and Tring 313) use both push and pull marketing approaches and have the "always-on"capability to monitor mobile users' whereabouts and send them LBAs automatically in geofenced areas (Patil et al., 2012).

5.2.1. Value chain

With the highest smartphone adoption rate in Asia Pacific (Magdrilla, 2013), Singapore has a high potential to diffuse LBAs successfully. Key players in Singapore's LBA value chain include advertisers, advertising agencies, LBA application developers, telcos, and mobile device users (Fig. 2). Innovative advertisers that consist of major brands, product retailers, and shopping malls are experimenting with LBAs to reach out to mobile consumers anytime and anywhere (Chen & Hsieh, 2012). Based on interview results, advertisers in Singaporean choose advertising agencies, telcos, or application developers to work for LBA campaigns. After advertising agencies develop advertising content and strategies, they have to collaborate with application developers to create location-based capability for mobile advertising and distribute them over LBS platforms and mobile and wireless networks (Chen & Hsieh, 2012).

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Table 1
Application-based LBAs in Singapore.

Application	Appeal	Approach	Operating system	'Always on' capability	Background
Foursquare	Check-in promotions	Pull	• iOS • Android • Blackberry OS • Windows Mobile • Symbian	No	Foreign LBS check-in app first used for LBA in Singapore; available on multiple operating systems
Elephanti	Check-in promotions	Pull	• iOS • Android	No	Local LBS app using check-in promotions similar to Foursquare
Hungry Go Where	Local search advertising	Pull	• iOS • Android	No	Local LBA app sending promotions from food and beverage outlets
Luxury Locator	Local search advertising	Pull	• iOS	No	Local LBA app featuring advertisements for luxury brands
Show Nearby	Local search advertising	Pull	• iOS • Android • Blackberry OS	No	Local LBS app later incorporates LBA
Sprooki	Daily deal promotion	Push & Pull	• iOS	Yes	Local LBS app named by the Singapore Business Review as one of the '20 startups to watch in 2013'
Tring 313	Daily deal promotion	Push & Pull	• iOS	Yes	A local mall-specific LBA app using the Sprooki system
PromoNear You	Daily deal promotion	Push & Pull	• iOS • Android	Yes	Local LBA app that automatically send ads to users within 500 meters near advertisers
Perx	Loyalty and reward card	Pull	• iOS • Android	No	Local LBS app; claim rewards after collecting the required number of stamps
Squiryl	Loyalty and reward card	Pull	• iOS	No	Local LBS app; claim rewards after collecting the required number of stamps
Around!	Loyalty and reward card	Pull	• iOS • Android	No	Local LBS app; claim rewards after collecting the required number of stamps

Alternatively, advertisers can bypass advertising agencies to reduce costs and work directly with telcos' advertising units or application developers for their LBA campaigns. Although telcos can only produce SMS and MMS ads, their bundled packages including ad content design and distributions cost less. These mobile device users can receive LBAs via distribution networks (e.g., telcos' mobile cellular network or Wireless LAN). As telcos in Singapore play a significant role in providing LBA services, its value chain is less fragmented.

In the converged value chain, LBA mobile application developers that monetize location technologies by creating pull-based mobile advertising with various incentives have brought new competition to telcos which have been producing and distributing profitable push-based SMS ads via mobile networks for years. Compared with the telcos who have millions of mobile subscribers as LBA recipients, application developers that offer free downloads can only send LBAs to limited users (Bhat, 2013). Telcos still have competitive advantages in distributing LBAs. However, some advertisers with marketing departments choose to work with application developers to create application-based LBAs when they are more concerned with designing LBS content and establishing location platforms for specific areas (e.g., malls and department stores) (Shopping mall manager, personal communication, 11 February 2013). Actors in the advertising value chain (i.e., advertising agencies, networks, and publishers) play a complementary role in developing ad content and strategies when telcos' ad divisions and LBA application developers can create LBA content with location-based capability and own distributing platforms and networks.

5.2.2. Industry players' attitudes towards LBAs

5.2.2.1. LBA opportunities. Interview results revealed industry adopters of LBAs shared similar promising projections for emerging LBAs in mobile advanced Singapore. Application

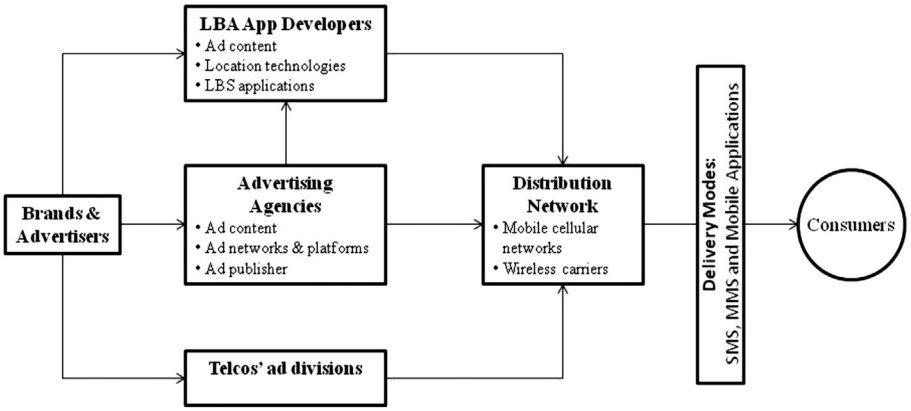

Fig. 2. LBA value chain in Singapore.

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developers thought Singapore's mobile users' shopping habits and commuting lifestyle were advantageous to LBA businesses. As a result of rapidly growing mobile advertising, creating LBA presents new business opportunities for LBS application developers. Application developer 1, the co-founder of a home-grown LBA application (personal communication, 27 November 2012), was determined to create application-based LBAs that "bring buyers and sellers in predefined hyperlocal areas." Ad network 2, the chief operating officer of a Singapore-based advertising network (personal communication, 20 December 2012) believed that location capability would drive the rollout of mobile advertising until brands and advertisers allocate a substantial amount of budget into it. The product manager of an advertising network has seen an increasing number of advertisers who showed interest in emerging LBAs (Ad network 1, personal communication, 6 December 2012).

Telcos regarded providing LBA services as a new means to show organizational innovativeness and keep competitive advantages in promising mobile advertising businesses. Telco 1's former product development manager (personal communication, 22 November 2012) emphasized that Singapore telcos' innovative and competitive cultures resulted in constant experiments in emerging mobile services without proven business models (e.g., LBA) so as to keep abreast of the latest technological developments. According to Telco 1, "the general sentiment around LBA in the mobile industry was [that it is an] additional enhancement layer on top of the mobile network that telcos have already invested so much money in." This explains why telcos made efforts to add value to the lucrative SMS ad services by adding location targeting capabilities.

5.2.2.2. LBA challenges. Facing competition brought by LBS application developers, telco interviewees showed confidence in their SMS advertising businesses which still take the lion's share of the mobile advertising market. Comparatively, mobile application LBAs are more complex in usage as advertisers have to set up hardware and customers must install applications before receiving LBA promotions (Application developer 1, personal communication, 27 November 2012; Telco 2, personal communication, 14 December 2012).

Nowadays creating LBA applications is less difficult after Android and Apple released application programming interfaces (API) to access location services. However, employing a skilled LBA application developer is essential to create consumer-centric LBAs. Application developer 1 (personal communication, 27 November 2012) emphasized that it is important to "look for a way to get accuracy in terms of identifying users' location to send them alert messages even when the applications were not turned on." She also mentioned the quality of network coverage as the other challenge. Outdoor network signals are not as strong when mobile users are indoors or on the Mass Rapid Transit (MRT), which may discourage the use of LBA applications. Also, consumers became demanding and selective about incentives offered by LBAs to induce consumers' responses (Application developer 1, personal communication, 27 November 2012; Shopping mall manager, personal communication, 11 February 2013). High discounts typically enticed consumers to purchase LBA-advertised products.

5.2.2.3. LBA evaluation. The LBMA's president (personal communication, 10 January 2013) emphasized the importance of realizing that "the true value of location is in understanding that it is a data point that can be used to make all advertising more relevant and contextual." Although LBA service providers (e.g., advertising agencies, telcos, and application developers) believed that locational information increased the effectiveness of mobile advertising, advertisers still had to be persuaded to adopt LBAs.

Mobile application developers were making efforts in improving the geographical preciseness of LBAs and seeking funding from the government or private sectors to upgrade locational technologies and platforms (Application developer 1, personal communication, 27 November 2012; Application developer 2, personal communication, 13 December 2012). In addition to location-based information, telco and advertising network interviewees considered integrating location data with other information (e.g., mobile users' demographic data, shopping behavior, and personal interests) in order to improve LBAs' relevancy, value, and effectiveness.

> "LBA gets you the message in the right place … but it doesn't necessarily get you the right message. And so, complementing location with your preferences is much more powerful than just location by itself" (Telco 2, personal communication, 14 December 2012).

Adding various user data in LBAs is likely to enable advertisers to target people with highly relevant advertisements (Ad network 1, personal communication, 6 December 2012; Ad network 2, personal communication, 20 December 2012; Telco 1, personal communication, 22 November 2012; Telco 2, personal communication 14 December 2012). However, using consumers' data to improve targeted advertising requires a balance of commercial benefits and consumer privacy (Ad network 1, personal communication, 6 December 2012; Ad network 2, personal communication, 20 December 2012).

Majority of the interviewed LBA service providers emphasized the importance of allowing consumers to opt-in before sending LBAs in order to uphold consumer trust. Mobile application developers embed the opt-in mechanism to ensure that only registered members can gain access to LBAs. Application developer 2 (personal communication, 13 December 2012) stated, "Right from the moment that our platform was created, it is opt-in. So people know that when they actually sign-up to our application, they are expecting to see rewards, deals and promotions pushed to them." Nonetheless, it will be appropriate to give consumers "different levels of preferences that go beyond the universal opt-in and opt-out" (Application developer 1, personal communication, 27 November 2012).

5.2.3. Advertisers' attitudes towards LBA

5.2.3.1. LBA opportunities. Although LBA developers and distributors shared optimistic forecasts of this emerging technology, advertisers who adopted LBAs as new means to reach potential

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mobile customers early did not expect immediate revenue in return. Most interviewed advertisers regarded LBAs as a complement to traditional advertising tools and used various ways to deploy LBAs.

One yogurt chain store subscribed to a local search LBA application to improve its brand presence and attract mobile consumers near them. Its CEO stressed the significance of including LBAs as part of their marketing tools because Singaporean consumers increasingly use smartphones to search for product and service information on the move (Retailer 2, personal communication, 6 December 2012). Another common strategy is to use LBAs to offer rewards to improve consumer loyalty. A beverage shop owner adopted an application-based LBA to offer such digital rewards to attract young smartphone users and create brand awareness (Retailer 1, personal communication, 15 November 2012). He believed such a strategy could stimulate consumers' repeated purchases.

The retail marketing head in a shopping mall (personal communication, 11 February 2013) adopted LBAs to develop digital campaigns to engage consumers. The mall initially used location-based SMSes to generate foot traffic and inform consumers of latest deals and promotions. After the prevalent use of smartphones, it collaborated with a local application developer to provide LBAs to convey promotional information of participating retail shops to consumers. Through the application, registered consumers can "browse" or "pull" special offers and promotion messages are pushed to customers nearby. LBA has the capability to intercept consumers in proximate areas where they are likely to purchase spontaneously. "There is a lot of traffic going in and out of the shopping mall and you really want to capture and to engage the shoppers there because they are the most ready buyers of the products" (Shopping mall manager, personal communication, 11 February 2013). She further emphasized that relevant LBAs with compelling incentives would be effective to attract foot traffic and stimulate impulsive buying behavior.

5.2.3.2. LBA challenges. Even with ready technology and a large number of mobile phone users, most vendors and shopping malls in Singapore were conservative in using mobile application LBAs as part of their advertising tools because of uncertain benefits and complex implementation (Application developer 1, personal communication, 27 November 2012; Shopping mall manager, personal communication, 11 February 2013). These early adopters emphasized the necessity of LBA service providers – either telcos or application developers –providing adequate technical support to implement LBAs and evaluate outcomes (Retailer 1, personal communication, 15 November 2012; Retailer 2, personal communication, 6 December 2012). More education is necessary to encourage the adoption of LBAs, in particular mobile application types.

> "I think people (advertisers) do not have deep knowledge on that (LBA), because things are changing so fast. We are in this digital age, everything just moves so fast. People are not aware of it. So I think more education have to be done" (Retailer 2, personal communication, 6 December 2012).

The shopping mall manager (personal communication, 11 February 2013) found that retailers in were "quite resistant" to using LBAs as they did not think using these emerging mobile advertisements fit their business models. Educational sessions in partnership with application developers were conducted to alleviate retailers' concerns about LBAs. In this mall, established brands mostly were convinced to participate in LBA campaigns but the majority of small to medium retailers had conservative wait-and-see attitudes. Advertising networks also saw that established brands were more open-minded in embracing LBAs (Ad network 1, personal communication, 6 December 2012; Ad network 2, personal communication, 20 December 2012).

5.2.3.3. LBA evaluation. Most early adopters thought LBAs could complement traditional advertising tools, especially for the purpose of engaging mobile consumers, and thus allocated a portion of their budget to it (Application developer 2, personal communication, 13 December 2012; Shopping mall manager, personal communication, 11 February 2013). The interviewed advertisers and mall managers decided to continue using LBAs as an integrated part of their marketing mix because they could send targeted consumers messages at the right time and the right place (Application developer 2, personal communication, 13 December 2012). They felt satisfied with using LBAs as an alternative to improve customer relationships even though tangible impacts of LBAs on their businesses were not yet clear and retailer and consumer awareness of LBA had to be increased (Retailer 1, personal communication, 15 November 2012; Retailer 2, personal communication, 6 December 2012; Shopping mall manager, personal communication, 11 February 2013).

5.2.4. Mobile consumers' attitudes towards LBA

5.2.4.1. LBA opportunities. The majority (87%) of the consumer interviewees in this study expressed familiarity with SMS and mobile application forms of LBAs. They often received LBAs and promotions from well-known food and beverage vendors. A recent survey in Singapore found perceived utility of advertising as a strong predictor of mobile phone users' affective attitude towards LBAs (Lin et al., 2014). In this study, more than half (53%) of the interviewees perceived benefits of LBAs as convenience (searching for deals) and time and money saving (purchasing products). Some interviewees viewed LBAs as hooks to encourage them to do shopping or attend events nearby. Three-fifths agreed with LBAs' short-term effects to attract foot traffic by giving incentives (e.g., vouchers and discounts) but felt dubious about LBAs' capabilities to give advertisers long-term benefits, particularly customer loyalty.

Based on consumer interviews, a pull approach of LBAs was more acceptable than a push approach, indicating that application-based LBAs are favored more compared with SMS ads. Two-fifths of the interviewees thought application-based LBAs gave them more control over receiving LBAs. Respondent 4 (personal communication, 19 March 2013) pointed out the importance of allowing consumers to have choices: "I just want to be given the option to decide when I want or don't want it. I think if I voluntarily check in (using Foursquare), knowing this will prompt deals or promotions, then I prefer that."

5.2.4.2. LBA challenges. 90% of the consumer interviewees expressed negative attitudes towards LBAs because of their experiences with push-based SMS ads. They tended to treat

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push-based SMS ads as spam (Respondent 2, personal communication, 19 March 2013). Respondent 4 (personal communication, 19 March 2013) who had an entrenched bias toward pushed LBAs said: "I feel whatever information they push to us is not useful at all. Unless it's something we want, we search for it." Respondent 11 (personal communication, 23 March 2013) felt annoyed when he was constantly disturbed by SMS ads sent by retailers in a mall. The negative impression of SMS ads was carried over to pull-based LBA applications which were usually received after smartphone users actively searched for nearby promotions.

Although LBA applications were helpful in discovering special offers in proximate areas, interview results showed that this form of advertising did not have significant influence on consumers' purchasing decisions for two reasons. First, they perceived LBA as a commercial source of product information which was less reliable than word of mouth (Respondent 3, personal communication, 19 March 2013). Second, most of the LBAs were irrelevant to them even though they received them in locations near the vendors. Respondent 7 (personal communication, 21 March 2013) complained that he received LBAs with offers for female products because such advertising was not precisely targeted.

Moreover, privacy concerns are the key inhibitor for mobile phone users' adoption of LBAs. Perceived sacrifice, especially privacy concerns, caused negative affective attitudes toward LBAs among mobile phone users in Singapore (Lin et al., 2014; Paragas et al., 2014). Older respondents and those with higher educational attainment tend to have greater privacy concerns in Singapore (Paragas et al., 2014). Smartphone interviewees in this study were concerned about how mobile operators, mobile application developers, or any third party used their information for commercial purposes (Respondent 2, personal communication, 19 March 2013). 47% of them expressed worries about their personal information being shared with advertisers and LBA providers. Two-fifths emphasized having control over LBAs with opt-in and opt-out options. Trust of LBA among Singapore's mobile phone users is likely to mitigate privacy concerns and implicit loss (Paragas et al., 2014). Therefore, it is essential to improve consumers' trust of stakeholders and regulations in order to enhance their positive affective attitude of LBAs.

5.2.4.3. LBA evaluation. Based on interview results, application-based LBAs in Singapore were still at an early stage of adoption as smartphone consumers just began to experience these pull-approach mobile advertising. The entrenched impression of push-based SMS ads as irritating was a major inhibitor for diffusing LBAs. The interviewed LBA service providers shared the view that even if privacy concerns were detrimental to diffusing LBAs, the perceived benefits of relevant LBAs could outweigh inherent privacy risk. Telco 2 (personal communication, 14 December 2012) optimistically stated, "If consumers are getting good value, they are happy to share their location and other personal data willingly." Consumer receptiveness to LBAs did not show optimistic responses. To change consumers' attitudes negative toward LBAs, service providers and advertisers ought to use pull approaches, improve ad value and relevancy, enhance consumers' control over receiving LBAs, and give considerations to personal data and privacy protection. Table 2 summarizes various stakeholders' perspectives about LBA's market and industry subsystem in Singapore.

Table 2
Stakeholders' perspectives of LBA market/industry subsystem in Singapore.

Sector	LBA Opportunity	LBA Challenge	LBA Evaluation
Telcos	• Organizational innovativeness • Keep competitive advantages • Create value-added mobile ad service	• New competition with LBA app developers • Lack of pulled mobile ads • Improve network coverage	• Integrate location information with other data to improve LBA relevance • SMS ads will stay
Application Developers	• Promising businesses opportunities by adding location capability to mobile ads • Fit Singaporeans' lifestyle • LBA apps suitable for shopping places • Friendly APIs for developing LBA apps	• Compete with telcos • Need to improve LBA apps' location accuracy and network coverage quality • Most retailers resist LBA apps due to complex technology and implementation	• Provide opt-in to uphold consumer trust • Necessity to seek funding to upgrade locational technologies and platforms • Necessity to provide technical support for LBA implementation • Increase LBA education for advertisers and consumers
Ad Agencies / Networks	• Positive market forecast of LBA • Increasing advertisers' interests in LBA	• Only established brands tried LBA • Early adopters only allocate small budget for LBA	• Collaborate with telcos or app developers by creating LBA content and strategies • Integrate location information with other data to improve LBA relevancy • Balance commercial benefits and consumer privacy
Advertisers (Early adopters)	• Perceive LBA's potential • Use LBA as part of the marketing mix • LBA apps improve brand awareness, customer relationship and foot traffic • Stimulate mobile users nearby for impulsive shopping	• Uncertain LBA effectiveness and ROI • Increasing consumer demand for higher incentives from LBAs • Non-adopters of LBA apps are conservative	• Feel satisfied with LBA as an alternative marketing tool • Unclear LBA impact to businesses • Necessity to increase retailer and consumer awareness of LBA
Smartphone consumers	• Perceive LBA values (e.g., convenient in searching near by promotions, time and money savings) • LBA effectiveness on attracting near by mobile users and foot traffic	• Majority perceive pushed SMS ads as spam causing bad impressions of pulled LBA apps • Negative attitudes toward LBAs • Concerns about privacy invasion and data protection	• Preferences of pulled LBAs to pushed ones • LBA apps at early stage of adoption • LBA providers' making effort to improve LBA value (relevancy) and reduce consumer concerns

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5.3. Government/regulation subsystem

The Singapore government has seen the potential of harnessing location technology for economic growth as part of its Intelligent Nation 2015 Masterplan (iN2015). In IDA's Digital Concierge (DC) program (one of the programs under iN2015), mobile applications and accurate location technologies (e.g., indoor GPS) are being developed to leverage on location-based services including LBA (Infocomm Development Authority, Singapore (IDA), 2007). With an investment of US$8 million, the DC program, which shows the government's strong support, encourages pervasive use of mobile applications and location technologies by local businesses (Huang & IDA, 2012). As location-based targeted marketing enhances businesses' capabilities to reach out to mobile customers, the government's initiative of developing location technology is beneficial to rapid LBA diffusion, especially to the target group of small and medium businesses (SMBs).

According to the legal counsel for Advertising Standards Authority of Singapore (ASAS) (personal communication, 27 November 2012), policy-makers tend to "let (emerging) technology lead and see how it develops" before making specific legislation and policy. So far, the Singapore government has not set any specific LBA regulation yet. In terms of LBA governance, several regulatory agencies are related to overseeing mobile advertising in Singapore. First, ASAS supervises ethical advertising by promoting self-regulatory measures in the local industry. Second, IDA regulates information and communications technologies and infrastructure, such as locational technologies. Lastly, the Personal Data Protection Commission (PDPC), which is established based on the Personal Data Protection Act (PDPA) of 2012, upholds consumer privacy and data protection.

The Singapore Code of Advertising Practice (SCAP), a non-legislative voluntary code, aims to regulate advertising content in Singapore. Enforced by ASAS, the code provides advertisers and advertising agencies/networks guidelines to ensure that advertising content is legal, decent, honest, and truthful (Advertising Standards Authority of Singapore (ASAS), 2008). The code can be applied to all advertisements regardless of media types, including LBAs (Legal counsel for ASAS, personal communication, 27 November 2012). Also, the Parliament of Singapore passed the Spam Control Act (SCA) on 15 June 2007 (Parliament of Singapore, 2007). Similar to US and EU anti-spam laws, it is deemed illegal to send unsolicited commercial communications in bulk by electronic mails or by SMS or MMS to mobile phone numbers. A breach of this Act will require spammers to pay victims S$25 per spam message to a maximum of S$1 million (Choo, 2007). It also enforces the placement of the "<ADV>" label to all electronic advertisements and a valid return contact number for sending an opt-out request (Wei et al., 2010). Spamming will result in financial penalty. M1 was fined US$100,000 for sending out spam SMSes to 300,000 mobile users and billing each user US$0.60 (Wei et al., 2010).

To serve as a trusted global financial centre and data hosting hub, the parliament passed the PDPA, a uniform comprehensive data protection legislation, in October 2012 and enacted it in January 2013 (Loh, 2012). This Act, which provides a light-touched baseline framework, governs the collection, use, and disclosure of personal data by all organizations in order to balance personal data protection and organizational needs (Parliament of Singapore, 2012; Ter, 2013). It requires informed consent to collect, use, or disclose consumer personal data, including location information, for only reasonable purposes. The PDPC has launched a 'Do Not Call' registry for consumers to register their telephone numbers to opt-out from receiving unsolicited direct marketing communications (e.g., voice calls, fax, SMS, and MMS) (Parliament of Singapore, 2007; Loh, 2012). Any infringement by business organizations will result in a financial penalty not exceeding $1 million. According to Chik (Chik, 2011), the PDPA holds the key to a more robust adherence of consumer privacy as compared with the SPAM act. It also can safeguard consumer rights better than self-regulatory SCAP. Although this Act presents challenges for Singaporean businesses, including LBA service providers and distributors, to develop compliance strategies for handling personal data, it is crucial for them to keep abreast with stricter international data privacy standards to remain competitive in the global digital economy (Loh, 2012). Table 3 shows three regulations related to LBA in Singapore.

6. Socio-technical analysis of LBA development

6.1. LBA Drivers and challenges in Singapore

Due to stakeholders' different perceptions of LBA, the discrepancies in perspectives turn into drivers and challenges shaping its developmental trajectory. Since 2007, push SMS ads have been prevalently used by industry players (e.g., telcos, advertising agencies, and vendors) for various brands and services but they play a supplementary role to mass media advertisements and have slow diffusion because consumers do not have respond enthusiastically to early mobile advertising. Currently, Singapore has advanced 3G/4G mobile networks and a high rate of smartphone ownership. The government, telcos, mobile app developers, LBS providers, and advertising agencies take a proactive approach to foster the growth of this new media. Due to a sophisticated wireless environment and shopping culture in the city-state, market reports optimistically forecast that location-based mobile apps will give impetus to fast-growing mobile advertising revenues. Nevertheless, despite the positive forces, there are two major obstacles to overcome before LBA can take off. On the one hand, lots of consumers who regard irrelevant SMS ads as spam carry over negative impressions to LBAs. They are concerned that LBA providers may invade their privacy and misuse their personal data. On the other hand, the majority of advertisers are conservative about adopting emerging mobile app-based advertising because of its uncertain effectiveness and complex technical implementation. Hence, the results show a promising future for LBA in Singapore after the aforementioned challenges are successfully tackled and resolved.

The socio-technical analyses show various aspects of the three subsystems of LBA development in Singapore and their interrelationships, including technology, market, industry stakeholders, consumers, government, and regulation (Fig. 3). In terms of the dynamic interactions between policy/government and technology subsystems, IDA takes a pro-innovative

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Table 3
LBA-related regulations in Singapore.

	Classification	Regulatory agency	Description
Singapore Code of Advertising Practice (2008)	Voluntary code	• Advertising Standards Authority of Singapore (ASAS)	Regulate all forms of advertising content
Spam Control Act (2007)	Legislative act	• Advertising Standards Authority of Singapore (ASAS) • Infocomm Development Authority (IDA)	Regulate unsolicited commercial communications (spam) sent in bulk by electronic mails or by SMS or MMS to mobile phone numbers
Personal Data Protection Act (2012)	Legislative act	• Infocomm Development Authority (IDA) • Personal Data Protection Committee (PDPC)	Provide guidelines for collection, use, disclosure and care of personal data (e.g., Do Not Call registry)

approach and facilitates the advancements of location technologies in order to improve the digital economy. In contrast, policy support is less clear and insufficient with respect to creating LBA software and content (e.g., R&D for LBS/LBA applications and interactive advertising). New application developers in particular face strong competition from telcos and require government funding to make a sustainable breakthrough.

While mobile infrastructure and locational technologies are advanced by the government, private entities (e.g., telcos, application developers, and advertising networks) make efforts to improve the preciseness of ad delivery and relevancy of LBA content. Seeing the commercial advantages of LBS businesses, IDA encourages small and medium advertisers to adopt the nascent LBA by promoting its strengths. Analyzing dynamic interactions between policy/government and market/industry subsystems, we identified huge barriers to consumers' attitude and trust of LBAs that result from the lack of a mobile advertising regulator and specific regulations to protect consumer privacy and personal data. With a pro-business LBA policy, many consumers demand more control over receiving LBAs and personal data protection. The newly established PDPC which provides guidelines to regulate collecting, using, and disclosing personal data for commercial purposes is a first positive regulatory step which is likely to increase individual willingness to use LBAs.

As for interrelationships between technology and market/industry subsystems, the advanced mobile infrastructure provides a good environment for industry players (LBA providers and advertising agencies) to build their mobile advertising services with less investment and more revenue in return.With location technology capability and app know-how, LBS providers and app developers become new entrants in the LBA value chain and bring disruptive competition to the existing lucrative mobile advertising market dominated by telcos. Currently, a few innovative early business adopters use LBA apps as a small part of their marketing mix to engage targeted mobile consumers, attract foot traffic, and increase customer loyalty. The majority still hold a conservative attitude towards this emerging mobile advertising because of perceived complex technical implementation and uncertain advertising effectiveness. Although LBA service providers (i.e., telcos, mobile application developers, and advertising agencies) optimistically forecast LBA's future as a result of targeted and

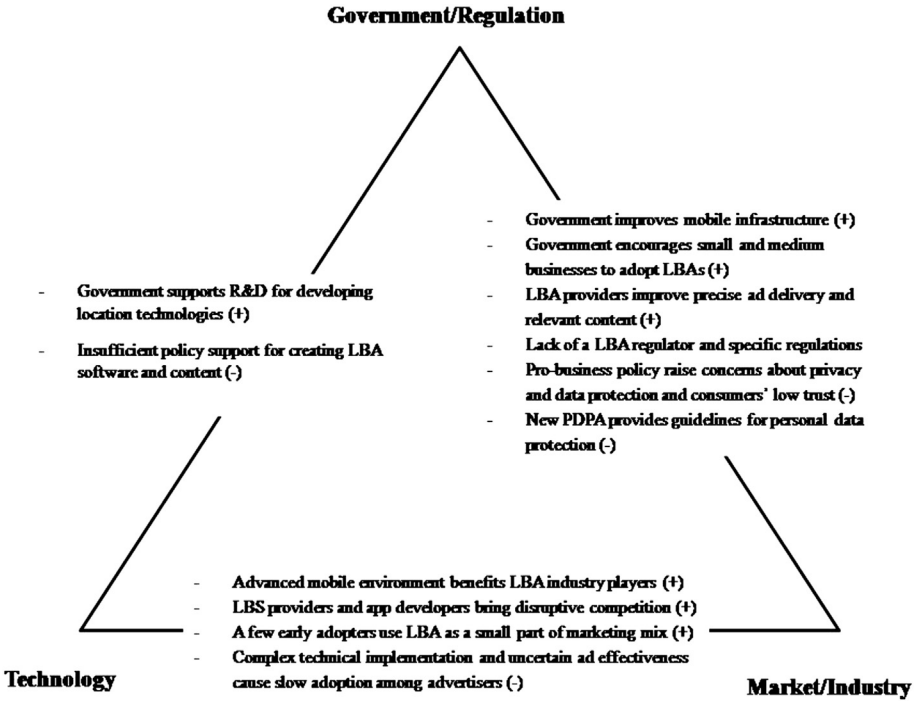

Fig. 3. Interrelationships of socio-technical subsystems of LBA.

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location-based capabilities, hesitant advertisers and negative consumer attitudes are hindrances to LBA diffusion.

In a nutshell, the socio-technical analyses indicate Singapore's LBA development is still at the early adopter stage. The results show that LBA in Singapore is technology-ready with government support and industry pull, but lack of consumer protection policies, conservative advertisers, and negative consumer attitudes inhibit its widespread diffusion in the near future.

6.2. Recommendations for other countries

The key socio-technical issues identified in Singapore's LBA development provide valuable lessons to make useful recommendations for other mobile advanced countries. On the one hand, they can help industry players develop competitive LBA business strategies which facilitate the diffusion of latest LBAs and reduce business and individual users' resistant attitudes. On the other hand, their government and policy-makers can make regulations to not only protect consumers' privacy and data protection rights, but also foster the development of emerging mobile advertising to boost the digital economy. Table 4 lists positive drivers for LBA development in three socio-technical subsystems (technology, market/industry, and government/regulation), and highlights recommendations for other digital-savvy countries about how to improve advancements and diffusion of emerging LBA.

7. Conclusion

The increasing use of LBS and mobile applications bring new momentum to the growth of LBA which enables advertisers to reach mobile consumers at a personal, targeted, and context-relevant level. This study, drawn from extensive document analysis and in-depth interviews with LBA stakeholders (i.e. industry players, policy makers, and consumers), examined the socio-technical subsystems of emerging LBAs in Singapore and identified positive and negative forces shaping its developmental trajectory. It addressed technological innovation, value chain, industry players' strategies, consumer responses and adoption factors, and regulatory influence. It also profiled key industry players including telcos, application developers, ad agencies/networks, and advertisers (early adopters). Most importantly, it takes into account the interactions of these factors in the socio-technical subsystems in order to see the dynamics of LBA development in Singapore.

With the government's pro-business policy, LBA ecology in Singapore constructs a less fragmented value chain when telcos are capable in creating LBA content and distributing them to millions of mobile phone users. Despite uncertain LBA effectiveness, innovative advertisers increasingly use it in their marketing mix to test market receptiveness and experiment with creative advertising campaigns. The findings reveal that consumers in this Asian LBA hub shared similar concerns (e.g., privacy, self-control, and personal data protection) about adopting these new mobile advertisements with people in other mobile advanced countries. However, Singapore's mobile advertising and LBA regulations which lead the South East Asia region still lag behind the privacy and data protection laws in the US and the EU. This explains why Singapore's consumers show skeptical attitudes and distrust in using these advertisements.

Whether an emerging technology can be diffused successfully in a social system involves complex interactive dynamics of key socio-technical actors. This study shows the value of analyzing stakeholders' different views (i.e., LBA challenges, opportunities, and evaluation) and actions (e.g., R&D, alliances, strategies, and policy-making) which shape the evolving trajectory of emerging mobile advertising technologies. The socio-technical approach is useful for studying emerging media technologies with an uncertain future because it can holistically untangle complex interrelationships between key stakeholders in socio-technical subsystems and clearly reveal how their different views and actions turn into drivers and challenges to

Table 4
Recommendations for developing LBA in Singapore's case.

Socio-technical sub-system	Drivers for LBA development	Recommendations for other countries
Technology	• Sophisticated mobile phone environment (prevalent wireless connectivity and high smartphone adoption rate) • Advanced locational technologies (increasing preciseness of LBA delivery) • Improvements in LBS/LBA apps, software and content/services	• Improve mobile environment, locational technologies and LBS/LBA services
Market/industry	• New entrants (LBS/LBA app developers) bring disruptive market competition. • Lower complexity in technical implementation and increase LBA effectiveness. • Innovative advertisers use LBA in the marketing mix. • Improve LBA relevancy with incentives (more pulled LBA) • Reduce consumers' privacy and data security concerns • Prior consumer consent	• Facilitate new entrants to create competitive and dynamic LBA market • Encourage small and medium businesses as well as innovative companies to adopt LBA • Early adopters' successful experiences are useful in persuading the early majority of advertisers to try out LBAs. • Foster R&D to improve LBA's technical implementation, ad effectiveness, and content relevancy and attractiveness • Change consumers' negative attitudes (e.g., campaigns to promote LBA and educate users; increase in consumer control and trust)
Government/regulation	• Establish a well-connected mobile infrastructure • Support R&D on location technologies and advancements in LBS/LBA services • Pro-innovation policy to encourage competition, new services, and organizational adoption of digital technologies • Specific regulator and regulations to protect consumers' personal data and privacy	• LBA policy interventions should balance pro-business goals and consumer right protection (i.e., privacy and personal data protection). • Improvement in LBA regulations will help gain consumer trust. (e.g., preventing LBA providers from misusing personal data, no spam).

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shape its developmental path. Practically, this case study contributes to provide empirical insights into LBA technology, market/industry, and policy/government subsystems in a digitally savvy and mobile-advanced context, and identify key actors and major developmental issues (i.e., technological infrastructure and advancements; value chain, and industry players' perspectives and strategies, market responses, and adoption factors; and government policy and regulations) in determining the trajectory of LBA in an early adopter stage.

Finally, this study calls for future cross-country studies to compare LBA key developmental issues and stakeholder discrepancies under a socio-technical framework, and investigate how culture plays a role in influencing the developmental trajectory of emerging mobile advertising and LBA.

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Appendix A

Table A-1
Expert interviewee list.

Category	Sector	Organization	Job Title	Date
Industry Player	LBA app developer	Application Developer 1	Co-founder	27 November 2012
		Application Developer 2	Co-founder	12 December 2012
	Vendor	Retailer 1	Owner	15 November 2012
		Retailer 2	Chief Executive Officer	6 December 2012
		Shopping mall	Head of Marketing for Retail	11 February 2013
	Ad agency	Ad network 1	Product Manager	6 December 2012
		Ad network 2	Chief Operating Officer	20 December 2012
	Telco	Telco 1	Former Product Development Manager	22 November 2012
		Telco 2	Head of Advertising	14 December 2012
Policy Maker		Advertising Standards Authority of Singapore (ASAS)	Legal counsel	27 November 2012
Others		Location Based Marketing Association (LBMA)*	President	10 January 2013

* e-mail interview.

Table A-2
Mobile consumers interview list.

Respondent ID	Age	Job Title	LBA Usage	Date
1	29	Assistant Manager	Previous adopter	March 19, 2013
2	27	Senior Executive	Previous adopter	March 19, 2013
3	25	Senior Executive	Non-adopter	March 19, 2013
4	26	Marketing Executive	Non-adopter	March 19, 2013
5	26	Disc Jockey	Adopter	March 21, 2013
6	25	Graduate Student	Adopter	March 21, 2013
7	29	Freelance Actor	Non-adopter	March 21, 2013
8	26	Graduate Student	Non-adopter	March 21, 2013
9	40	Civil Servant	Non-adopter	March 23, 2013
10	35	Personal Assistant	Adopter	March 23, 2013
11	40	Manager	Previous adopter	March 23, 2013
12	35	Defence Officer	Non-adopter	March 23, 2013
13	32	Senior Manager	Non-adopter	March 23, 2013
14	33	Technic Service Engineer	Adopter	March 23, 2013
15	32	Unemployed	Adopter	March 23, 2013
16	30	Mechanical Engineer	Adopter	March 23, 2013
17	31	Graduate Student	Non-adopter	March 23, 2013
18	34	IT Technician	Non-adopter	March 31, 2013
19	32	Business Developer	Adopter	March 31, 2013
20	33	Hedge Fund Manager	Non-adopter	March 31, 2013
21	32	Pilates Instructor	Non-adopter	March 31, 2013
22	35	Landscaper (self-employed)	Non-adopter	April 5, 2013
23	38	IT Executive	Non-adopter	April 5, 2013
24	36	General Manager	Non-adopter	April 5, 2013
25	34	Teacher	Non-adopter	April 12, 2013
26	28	Lecturer	Adopter	April 13, 2013
27	37	Lecturer	Non-adopter	April 13, 2013
28	28	Teacher	Non-adopter	April 13, 2013
29	36	Sales Director	Previous adopter	April 14, 2013
30	40	Housewife	Non-adopter	April 14, 2013

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