MULTI POS Multitechnology Positioning Professionals

MARIE CURIE ACTIONS

MULTIPOS

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Report on evaluation and assessment of LBS solutions, markets and models

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Abstract: This document describes market of Location based services from technical, societal and economic point of view.

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Executive Summary

This document describes current markets of Location Based Services (LBS) through reviewing relevant market reports and papers. It identifies the market drivers, the challenges, trends and issues to the current markets of LBS.

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List of Acronyms and Abbreviations

Term	Description
CAGR	Compound Annual Growth Rate
ER	Experienced Researcher
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
ITN	Initial Training Network
LBS	Location Based Services
MultiPOS	Multi-technology Positioning Professionals
SWOT Analysis	Strength, Weakness, Opportunity, Threat Analysis
LBSN	Location Based Social Networking
IoT	Internet of Things
IVS	In-Vehicle Systems
BLE	Bluetooth Low Energy
UAV	Unmanned Aerial Vehicles
API	Application Programming Interface
IO	Input-Output

1.   Introduction

This document, the deliverable D2.9, describes current markets of Location Based Services, assess the requirements, challenges, trends and potentials of LBS markets. This document gathers information about current markets of LBS, key players, value chains from individuals (through interviews and meetings), available market reports (limited to freely available data) and papers and interprets such information using statistical and analytical methods and techniques to gain insight regarding the remaining challenges, issues and potentials of LBS markets and the requirements for future growth. It also looks at a number of aspects that are relevant to current and future trends in LBS.

This document partially reports on the findings and outputs of MultiPOS (Multi-technology Positioning Professionals) research project within Marie Curie Initial Training Network (ITN). Objectives of this research project, entitled "developing markets for Location Based Services (LBS)", are as follow:

- To understand the requirements of the technology for future of LBS;
- To assess LBS market, applications, challenges;
- To assess the market forecast and future trends.

This document is mainly a report on the first and second objectives of the project.

In order to analyse the market and provide solutions to bridge the gap between requirements and future demands, the methodology that has been taken is, firstly, studying LBS current market conditions, trends and directions. Reviewing relevant market reports, having face-to-face interviews with key players of the market and/or market report producers and also conducting online surveys are some of the well-known approaches to well-understand current conditions of the market. Then upcoming events, planned actions or actions which have been already taken, and might have impacts on the future market of LBS should be considered and reviewed. This helps to have a better understanding of future potentials, challenges and opportunities. Afterward using available or developed models, it is possible to estimate the economic impact of such events and actions in future market of LBS. Finally considering underlying trends, market conditions, upcoming events and challenges, future market of LBS can be estimated. In addition, current market challenges and technological requirements need to be addressed. In this regard, new business models should be developed, new policies and standards should be issued to address identified challenges.

To implement this methodology, the markets reports, whitepapers, market surveys, notes that are dedicated to or to do with LBS (and its components') market have been reviewed. They include, research papers and market reports (and/or market description summaries) produced by Berg Insight, ABI research, Pyramid Research, Gartner Group, Juniper Research, MarketsandMarkets, GSA, Frost and Sullivan Analysis, McKenzie Global Institute, European Mobile and Mobility Alliance, Open Europe, market survey reports including Galileo Ready Advanced Mass Market Receiver (GRAMMAR) questionnaire summary, State of the GNSS industry report, books including GNSS markets and applications, Location Based Services and GeoInformation Engineering, Future Ready: how to master Business Forecasting, Financial Reporting and Analysis and also following business news, journals and magazines to do with LBS markets.

Details of this methodology, current markets characteristics and conditions, assumptions, preliminaries and boundaries in LBS market analysis, models and finally outputs and results are described in this document. This document is structured as follows; next section explains process of market analysis and market research methodology and steps. Section three summaries currently available market reports,

underlying trends. Last section describes the challenges, available solutions and practicality and efficiency of them.

2. Location Based Services Market Analysis: Approaches and Assumptions

This section explains methodologies and approaches of market analysis, specifically for Location Based Services (LBS) market and its outputs, describing the reasons of choosing a top down approach for this research project and explaining each step of the analysis.

2.1 Market Analysis

Market analysis is a systematic, objective collection and analysis of data about the target market, competition, and/or environment and goals should be to increase the understanding of them. A market analysis is essential to determine if there is a need for new idea, technology, service, policy, standard or product and to determine the correct approach to fulfilling this need.
Market analysis can have following dimensions and aspects as its outputs; market size (current and future), trends, growth rate, market profitability, cost structure, distribution channels, key success factors, market drivers and obstacles. In some specific areas, including indoor LBS, if market analysis is done properly, the findings and conclusions can have a value that exceeds the cost of the research itself. This is probably the most important reason why there are many market analysts and researchers have done LBS market analysis. There are many useful reports describing different aspects and dimensions of indoor LBS market, including Berg Insight (2013), ABI research (2014), Pyramid Research (2014), Gartner Group (2009), Juniper Research (2014), MarketsandMarkets (2014), GSA (2015), Frost and Sullivan Analysis, McKenzie Global Institute, European Mobile and Mobility Alliance, Open Europe and many more.

Conducting market analysis provides with enormous advantages including:

- Identifying opportunities in the marketplace: Research might make it obvious that a new product, technology or policy, which have planned, may not be what the market wants or needs. Market players may then decide to make modifications on what was going to offer to suit the audiences.
- Minimizing risks: Through market research, all the information one needs to decide whether to take action on a particular subject should be found, there are sometimes useful best practices and recommendations regarding when and how to take such actions. A market research report/study identifies the market drivers, trends, challenges, main competitors, market size, segments and other information. Therefore decisions are being made more robust.
- Uncovering and identifying potential problems: Potential reactions (from customers, competitors, value chain's key players, etc.) to a new product, technology, standard, policy or service can be estimated when it is still being developed. This should enlighten any further development so it suits its intended market.
- Planning ahead: Research can estimate the likely revenue of a new product/service/application and also policy and standards needed to achieve maximum profits (financially and societally).
- Helping to establish trends: It is very important to know that market research is not an activity conducted only once. It is an on going cycle, or at least it should

be if the real benefit is targeted. Therefore there are a lot of data sets to be able to analysed customers and establish any particular trends.

- Helping to establish the market positioning: It's important to know the position of an up-coming business at particular moments in time. Information from market research helps to benchmark and monitor its progress, which can be useful to make decisions and take action.

- Determining the most persuasive "promises": Any new service, technology, policy or standard is to handle a challenge or open up new opportunities in the market. However there are some "promises" which are not met. A market research report can identify real-world challenges and threats, requirements and needs, trends, and opportunities. Therefore it can help in two directions; first to define more persuasive and achievable promises and also to estimate their impact on the market to understand a new product/service/policy's profitability.

- Finding that compromise: The team involved in the launch of a new product, service, application, policy, standard or technology all have their individual perceptions and gut feelings. These certainly should not be ignored, but by going straight to the target audience, thoughts and opinions from people who may be less biased or less emotionally attached to a new development or service can also be gained. It helps gain a new angle, hopefully a compromise in just how to release or lunch new product, service, application, policy, standard or technology.

2.2   Market Analysis Approaches

As it mentioned previously, the goal of market analysis is to determine the attractiveness of a market, both now and in the future. There are mainly two approaches to analyse markets; top down and bottom up.

The top down approach analyses the market (in this paper; indoor LBS market) by starting from the whole market overview; it looks at the "big picture" first, and then analyses the details of smaller components, see figure 1. The top down approach, firstly, start analysing the overall picture of the market, such as a macroeconomic trend, an investor and then narrowing potential companies.

On the other hand, the bottom up approach starts from the sub-segments, clusters and components and then gathers all of the components' contribution in final estimation, see figure 2. In order to analyse the market of LBS, within this project, the top down approach has been chosen. The most important reason for this is having access to large enough market reports specifically or partially analysing LBS market. In addition due to the project's timeframe and available resources (including number of experienced enough analysts working on this projects), having access to sub segments and most of market players was not the best approach, while there are large enough number of market reports, analysing the LBS market, which has been made available or their essential and relevant parts, data or assumptions have been made available for free through sample documents or by contacting analysts or contact points who have been mainly or partially involved in the market analysis and forecasting process. Availability of these LBS market reports and/or information, including total LBS market size and segments, assumptions, LBS market analysis/research methodology make it easier for this project to apply a top down approach. However in order to update available data, validation of available market report findings and also evaluate the results of our analysis, key players of the LBS market have been continuously contacted and/or research resources have been updated.

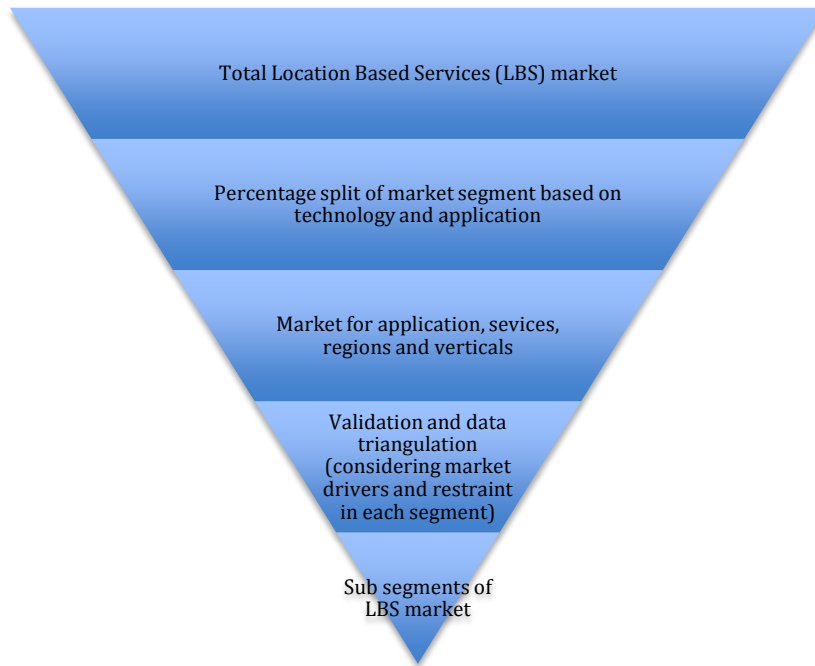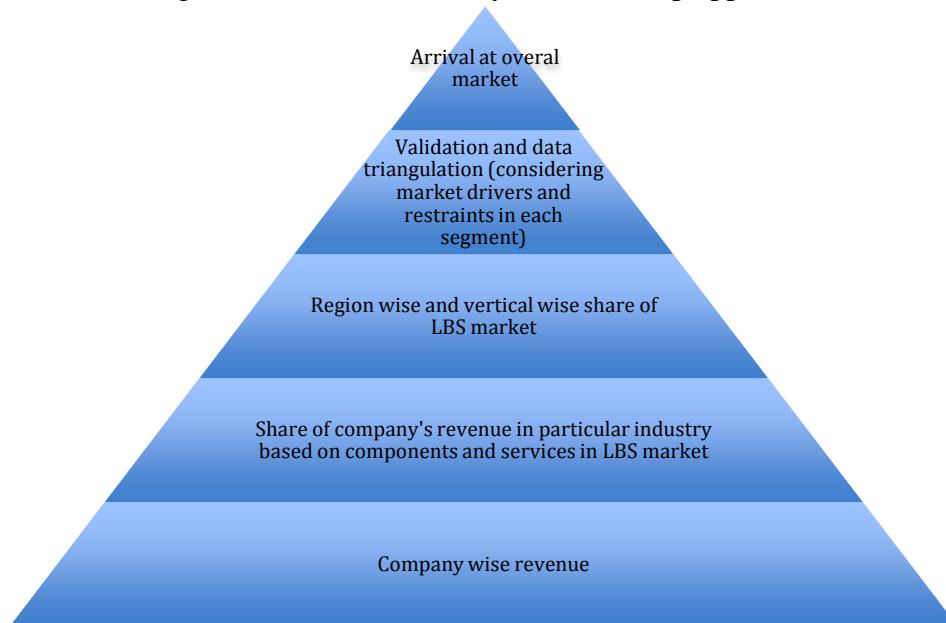Figure 1. LBS market analysis: the top down approach

Total Location Based Services (LBS) market

Percentage split of market segment based on technology and application

Market for application, sevices, regions and verticals

Validation and data triangulation (considering market drivers and restraint in each segment)

Sub segments of LBS market

Figure 2. LBS market analysis: bottom up approach

Arrival at overal market

Validation and data triangulation (considering market drivers and restraints in each segment)

Region wise and vertical wise share of LBS market

Share of company's revenue in particular industry based on components and services in LBS market

Company wise revenue

In order to have a better understanding of the LBS market and its application, at first, the boarder of the study was set. This includes defining what services and applications are considered as "LBS". These assumptions are very important to understand where to look at and how far the economic impact of an upcoming technology or a new standard and policy should be considered.

2.3   Location Based Services Market Boundaries

One of the very earliest steps in any market analysis is identifying the area of business contribution. Identifying what type of product/service should be included and what should be excluded is very essential. Similarly for LBS market analysis, the services and applications, which are based on the "location", should be identified firstly. In this

regard, LBS definition plays a strong role since it decides what applications and services can be considered as LBS and what should be excluded the market analysis process. However LBS definition, itself, does not have clear boundaries; If LBS is defined as any type of service which uses location data to exclude irrelevant responses (as mentioned in many reports and papers), then number of LBS users will dramatically increase since thanks to GeoLocation API and HTML5, any internet or even off-line mobile user is now provided with LBS as browsers' language settings and mobile phones' time and date is changing according to user's current location; i.e. country. Based on this definition if a mobile phone local time is changed automatically or web browsers' UserInterface (UI)'s language is changed based on the country where user is, then almost everyone is an LBS user and a portion of any mobile app revenue should be considered as LBS revenue.

On the other hand, some definitions consider the essentiality of location for the service or some definitions exclude services from LBS, if they do not use real-time locations of users to provide service. According to each definition a set of services and applications are included in the LBS market analysis process while it might be excluded by another definition. Consequently, the number of LBS users, size of the revenue and LBS growth rate can be extremely different in different market reports; According to Pew Internet Project report (Pew Report. 2013) 74% of adult Smartphone owners ages 18 and older use their phone to get Location-based services, such as getting directions or other information based on their current location. While TNS's annual Mobile Life study (2012) estimated only one fifth (19 per cent) of the world's six billion mobile users are using LBS, with more than three times this number (62 per cent) aspiring to do so in the future.

Such kind of extreme different, and sometimes conflicting, reports are the consequence of having different definitions for LBS and also related concepts such as location, accuracy, service, etc. behind the scene.

LBS has got a very large market; however due to its definition vagueness, it is not easy to put a bounding box and say what are inside are LBS applications, and the rest is not. Consequently, current market size estimation does not have the same results in different reports and whitepapers. This becomes more differing when it comes to the LBS market forecast.

LBS market has got a broad nature of its applications. Positional data has been a key component of many applications. This makes it difficult to identify a crisp boundary for LBS. Every time it is tried, a new set of applications pops up and suddenly there is revenue that left out of a previous model. Even if the revenue from a new application is apparent, the question arises as to what part of the product or service should really be included in the LBS market (Jacobson, 2007).

In summary, vagueness of the LBS-related concepts, boundaries of LBS applications, different possible ways for LBS market segmentation, quantification of impact of social and political views and legislations and many other challenges make LBS market reports and whitepapers very different if not contradictious.

From one point of view some location-based applications and services may be excluded from LBS market analysis process, while another view includes them. This impact is studied in more detailed later but here some examples are provided to understand the significance of it;

Gartner Group forecasts the revenue generated by consumer location-based services to reach $13.5 billion in 2015, of which advertising will be the dominant contributor (Gartner Group Report, 2012). Slightly different, Pyramid's research predicts that the global location-based services market revenue to reach US$10.3bn in 2015, up from

$2.8bn in 2010 (Pyramid Research Report, 2013). Meanwhile, Juniper Research expects revenues from mobile location-based services to more than $12.7 billion by end of 2014 (Juniper Research, 2012). According to Juniper Research, navigation with maps and GPS is identified as the most popular motivation behind the LBS uptake (46 per cent), but there is growing interest in more diverse activities, with 13 per cent of current social network users 'checking-in' through platforms like Foursquare, or Facebook according to this report.

MarketsandMarkets's recent report (2014) forecasts Location based services market to grow from $8.12 billion in 2014 to $39.87 billion in 2019. This represents a compound annual growth rate (CAGR) of 25.5% from 2015 to 2019. While according to IT research team Berg Insight report (2013) the LBS market in North America is forecasted to grow at a compound annual growth rate (CAGR) of 16.1 percent from $1.8 billion in 2013 to reach $3.8 billion in 2018, see figure 1. This report estimates LBS revenues in Europe to grow from €735 million ($1.01 billion) in 2013 at a CAGR of 25.8 percent to reach €2.3 billion ($3.1 billion) in 2018. Berg Insight estimates that about 50 percent of all mobile subscribers in Europe were frequent users of at least one location-based service at the end of 2013. It also expects the main growth will come from increasing ad revenues in the social networking and local search segments. With a different hypothesis, European Space Agency (GSA report, 2013) considers all GNSS-enable devices shipment as a part of LBS market (Hardware as a Service). It forecasts that only in the EU-27 countries, shipments of GNSS-enabled devices will grow from €218 million to more than €600 million per annum by 2022 while global GNSS-enabled markets are forecast to grow to approximately €250 billion per annum by 2022 and the core revenues (these attributable to GNSS functionality and service directly) are expected to reach over €100 billion in the same time.

ABI research reports distinguish between location-based services and location enabled services. According to ABI research 2012, global revenue of LBS reaches to 8 Billion dollars and the two most widely used LBS applications are navigation and enterprise, respectively.

As it explained, there are differences in regards of LBS market segmentation, market size, number of subscribers and most appreciated applications and their revenue. It is very important for market report to clarify what they mean by location-based service, what is included and what is not. This document analyses different market reports bearing in mind the impacts of having different market boundaries. The assumptions, findings and identified trends and challenges of the reviewed market reports are summarised in the next section

3.   Market Report Analysis

Reviewing published market reports are one of earliest steps in the process of market analysis. There are many market reports about LBS and related concepts, including positioning and location technologies, mobile applications, and context-aware services. This section summaries the outputs and findings of the (freely) available market reports.

ABI Research

The market report from ABI Research highlights the retail/shopping, ambient intelligence, hyper-local social and personal asset tracking/BLE beacon applications as emerging segments of LBS which play an important role in the next wave of location based services over the next five years, with ABI Research forecasting a four-fold increase in revenues by 2019.

ABI Research believes the market is also shifting geographically (mainly in BRIC countries), technologically (particularly HTML5, indoor positioning) and vertically (e.g. tablets, cameras), creating new opportunities.

In another report published by ABI Research, the platforms and enablers of LBS are studied. ABI believes that despite relatively stunted growth thus far, the tablet and camera markets are the next major market for location-based services and GPS IC penetration. ABI Research's latest Report, "Location Applications for Tablets, eReaders, Digital Cameras & Handheld Gaming," forecasts the uptake of LBS and how it will affect the adoption of location technologies. GPS shipments are forecast to reach 37 million in 2012, yet it is still much less than had been previously anticipated. Surprisingly ABI sees Wi-Fi location as a standard feature across all major tablets and it believes while it is complementary, it does act as a barrier to GPS integration.

ABI Research believes that ubiquitous location becomes a necessary component, which introduces a big challenge to current markets. And the camera market has huge potential, with Geo-tagging a clear driver. With more than 30 GPS-enabled cameras on the market, shipments are expected to break 10 million in 2013, and a second wave of new applications emerging around tracking, maps and points of interest, and dead-reckoning. As an industry, there needs to be a complete overhaul of how cameras are designed, to find a way to leverage the photography revolution occurring on smartphones. ABI Research has forecast that this will open the door to GPS, alternative location, and LBS in future.

The launch of the Sony Vita was expected to kick-start the location-based gaming (LBG) industry, featuring Wi-Fi location as standard, and an optional GPS/modem module. Location-based gaming and community applications still have fundamental barriers concerning critical mass and where and how the device is used. As a result, LBG is expected to initially flourish on smartphones, with GPS forecast to remain subdued on gaming devices."

Furthermore, in a reversal of previous LBS application trends, ABI Research expects to see many Asian, particularly Chinese, companies expanding into international markets in the future.

Yet another report published by ABI Research studies an important and challenging aspect of LBS; the indoor location. The indoor location market is forecast by ABI Research to reach $4 billion in 2018, fuelled by wireless technology as well as vendors offering venues such as shopping malls, warehouse retailers, airports and stadium products to provide content and services to mobile device users based on their location. The overall number of indoor location technology is expected to top 25,000 in the next year, while mobile devices capable of supporting indoor location services will reach hundreds of millions within two years.

- **Berg Insight**

Berg Insight published several report regarding different aspect of LBS. One report dedicates to Location Based Advertisements (LBS) market; another report for LBS market and an updated version of this, with slightly different application segmentation, on mobile LBS. Obviously, Berg Insight does not consider LBA as a part of LBS application segments, as market size of location-based Advertising is much bigger than LBS. Here some highlights of the relevant reports are discussed.

LBS market research forecasts that global LBS market reaches nearly 4 billion dollar by 2018 across different verticals. The Berg Insight Report studies LBS market in different geographical regions. It estimates that mobile location-based service (LBS) revenues in Europe are to grow from €325 million in 2012 at a compound annual growth rate (CAGR) of 20.5% to reach €825 million in 2017. The North American LBS market is forecast to grow, far slower, at a CAGR of 9.2% from US $835 million in 2012 to reach US $1,295 million in 2017.

In addition to regional revenue studies, Berg Insight analyse LBS market from subscribers. According to Berg Insight report, at the end of 2013, 67% of North Americans and 58% of Europeans (EU27+2) were using smartphones. About 50% of all mobile subscribers in Europe were frequent users of at least one LBS app at the end of 2013 while in North America this number is slightly higher (60% of all handset users)

It estimates that 40% of all mobile subscribers in Europe use some kind of location-enhanced application on a regular basis. In North America, the larger installed base of GPS-enabled handsets and smartphones has enabled higher uptake of LBS. Berg Insight estimates that about 50% of all mobile subscribers in the region now access LBS at least monthly. According to Berg Insight report Local search, social networking and navigation services are the top application categories in terms of number of active users.

As it mentioned earlier Berg Insight recently published a report regarding Location Based Advertising (LBA) and estimated that LBA market to grow up to 10.7 billion in 2018. Obviously in the previous report LBA has not been considered as an application of LBS. This can easily shows important impact of having different definition and assumption on the market size.

Berg Insight expect that the total value of the global real-time mobile location-based advertising and marketing (LBA) market will grow from € 1.2 billion in 2013 at a compound annual growth rate (CAGR) of 54% to €10.7 billion in 2018. This will then correspond to 38.6% of all mobile advertising and marketing. Location-based advertising and marketing will thus represent around 7% of digital advertising, or 2% of the total global ad spend for all media. Bluetooth low energy (BLE) is mentioned as one of the most impacting technologies. Berg Insight anticipates that beacon adoption will take off as retailers launch innovative marketing schemes and leverage the possibility to analyse how customers roam and dwell in stores and aisles.

According to another report published by Berg Insight, mobile location-based service (LBS) revenues in Europe are forecasted to grow from € 735 million in 2013 at a compound annual growth rate (CAGR) of 25.8% to reach € 2.3 billion in 2018. The North American LBS market is forecasted to grow at a CAGR of 16.1% from US$ 1.8 billion in 2013 to reach US$ 3.8 billion in 2018. The main growth will come from

increasing ad revenues in the social networking and local search segments. Berg Insight estimates that about 50% of all mobile subscribers in Europe were frequent users of at least one location-based service at the end of 2013. In North America where adoption of GPS-enabled handsets is still somewhat higher, an estimated 60% of all handset users now access location-based services at least monthly.

This report acknowledges that there are many ways to segment LBS applications. In this report, Berg Insight divides mobile LBS into eight service segments: mapping and navigation, local search and information, social networking and entertainment, recreation and fitness, family and people locator services, mobile resource management, mobile advertising, as well as other enterprise and B2B services. Berg Insight believes that the social networking and entertainment category is now the largest LBS segment, both, in terms of number of users and revenues. It defines this category as a broad set of services that can be segmented into general social networking, chat and messaging apps, friend finders and location-enhanced games. Mapping and navigation is the second largest segment in terms of revenues and the third largest in terms of number of active users. Although the number of active users of mapping and navigation services is still growing, revenues are only increasing slowly as competition from free and low cost services has intensified. More navigation service providers are now focusing on freemium apps where the core navigation service is free and users have the option to purchase additional content and features. Local search and information services are now the second largest LBS category in terms of unique users.

- **MarketandMarket**

MarketsandMarkets has published the market boundaries, assumptions (summarised in table1) and definitions used in the recent report, "Location Based Services (LBS) Market—Worldwide Forecasts and Analysis (2014-2019)". This helps to (partially) customise the outputs of this report easier respect to new sets of assumptions, change in the robustness of the hypothesis, and new needs.

MarketsandMarkets defines LBS as an information service provided by a device that knows where it is, and modifies the information it provides accordingly. According to this definition, MarketsandMarkets forecasts Location based services market to grow from $8.12 billion in 2014 to $39.87 billion in 2019. This represents a compound annual growth rate (CAGR) of 37.5% from 2015 to 2019. This report classifies the global LBS market on the basis of technologies, services provided, applications, end users, regions, and target audience. On the basis of applications, this report segmented LBS market into seven segments; mapping, infotainment and discovery, business intelligence and analytics, emergency support and disaster management, leisure and social networking, location-based advertising, games and augmented reality, and tracking.

On the basis of technology, MarketsandMarkets considers six positioning technologies (Cell Identification (Cell-ID), Enhanced Observed Time Difference (E-OTD), Observed Time Difference Of Arrival (OTDOA), Assisted GPS (A-GPS), Enhanced GPS (E-GPS), Hybrid Technology) and believes that among the various technologies, hybrid technology is emerging and is expected to grow tremendously in the near future.
In regards of end users, this report studies following verticals: Academia and Education, Banking, Financial services and Insurance (BFSI), Healthcare, Government and Defense, Retail, Media and Advertisement, Manufacturing, Oil and Gas, Transportation and Logistics. MarketsandMarkets believes the governments across the globe are taking initiatives and investing hefty capital to promote the growth of this market. The retail, and food and beverages industries are the two major industries where LBS devices are increasingly being used to reduce the transportation costs. Also MarketsandMarkets studies the regional LBS markets in North America, Asia Pacific, Europe, Middle, East and Africa, and Latin America.

MarketsandMarkets expects that the increase in the number of Smartphone users will lead to further comprehensive smart alerts related to LBS. According to this report, the market for LBS technology is expected to grow due to several factors including availability of cheaper GPS enabled devices, high interest in personalizing services based on users' location information, advancements in analysis capabilities, global deployments of 3G and 4G wireless services promising ubiquitous connectivity as well as cost benefits from deploying solutions like vehicle tracking and management. MarketsandMarkets thinks the major areas of opportunities includes navigation, local search, enterprise services, mobile location-based advertisements, location specific health information, tourism, consumer tracking and location based business intelligence. MarketsandMarkets considers concerns about privacy, cost, and government regulations as challenges in the adoption LBS. However the general trends is wide acceptance of LBS applications across various verticals.

Table 1. MarketandMarket forecast assumptions

Factor	MarketandMarket Assumption	Certainty of Assumption	Impact
Economy	A positive economic climate will continue globally till the end of 2018. The US and Japan will grow at a steady rate, on account of a lag in the rate of market penetration.	Moderately High	A positive economic climate means positive spending with a strong focus on business cases and short-term, mid-term and long-term results.
Political Stability	Stability in majority of the region covered, despite the uprisings in Arab nations, Afghanistan and Iraq. This tension, in general, will not hamper the economic growth.	Low	Despite a few political debates and other minor issues over telecom, the outlook towards the telecom market will be positive.
Exchange Rates	Dollar fluctuations will not be serious enough to affect the forecasts to a significant extent.	Low	Stability in the dollar will stabilize the price of imports and exports.
Government Spending Pattern	A stable and moderate spending pattern is assumed.	Moderately High	This encourages adoption of the LBS among end users.
Financial Statistics	MarketandMarket extract all revenue and financial insights from the company website or its annual reports.	High	The authenticity of the financials has a big part to play in the overall market sizing exercise.

- **PROGRESS**

Like GSA report, PROGRESS report focuses on GNSS and under this topic it evaluates the economic and societal impacts and challenges/threats of GNSS from different application segments including LBS. This report enumerates the social and economic benefits offered by GNSS, although it admits GNSS pervasiveness and applications make it difficult to exactly quantify all direct and indirect economic effects.

This report defines Location‑ Based Services (LBS) as a class of information services that use location/geographic data. It believes that the LBS market and number of users and devices has faced enormous growth over the last years and LBS revenues are an estimated €735 million in 2013, expecting to grow up to €2.3 billion in 2018. It found the social networking and entertainment as the largest segment in terms of users and revenue. Mapping and navigation comes as second in term of revenue and third in term of users. Local search and information services segment is the second**.**

PROGRESS report divided the market in two sides; the supply side and the service providers. The supply side consists of the space manufacturing industry, which produce GNSS satellites and the service providers, enabling end users to utilize GNSS data for a wide range of applications and infrastructure to enable them to function and traffic data. The supply side market, itself, consist of two market types

- The institutional market – including public entities – accounts for an estimated € 3.5 billion (or 53%of European space industry's business (Eurospace, 2013)). ESA is the dominant contributor to this business (67%). Other contributors are National Space Agencies (23%), defense /military entities (8%), Eumetsat (1%) and the European Commission (1%).
- The commercial market accounts for an estimated €3 billion and can be divided into three main segments:
    1. Complete satellite system (59% of the market),
    2. Complete launcher systems (27%) and
    3. Equipment, parts (for export), EGSE/MGSE (14%).

In regards of service side of the market, the PROGRESS report, similar to GSA report, considers 6 market segments; LBS, Road, Aviation, Rail, maritime and agriculture. PROGRESS is an EC funded project; also it has used many foundlings of GSA report, including segmentation, definitions and application descriptions. However, in contrast with other segments, PROGRESS uses another definition for LBS and therefore estimates its market size far smaller than what GSA estimates. It defines Location‑ Based Services (LBS) as a class of information services that use location/geographic data. It estimates the LBS market and number of users and devices has faced enormous growth over the last years. Similar to Berg Insight report, PROGRESS estimates LBS revenue around €735 million in 2013, expecting to grow up to €2.3 billion in 2018.

PROGRESS believes that the main goal of a GNSS system recently has changed and it is no longer providing service to military or surveying. It is now primarily to locate an LBS‑ device and also allow it to navigate in 3D, estimate its velocity in 3 axes, and broadcast the time reference information.

- **MicroMarketMonitor**

MicroMarketMonitor believes that Location Based System market bounding box will vary as per the application. Thus, MicroMarketMonitor defines LBS using two case scenarios:

- First case: Applications, which require fully dedicated devices and sub-markets. These include Application Software Market, Positioning & Tracking Components (GPS and dedicated LBS RFID), and LBS Service Server market. Application such as Navigation using GPS and inventory tracking using RFID tag LBS systems comes under this category.

- Second Case: Applications, which require partially contributing devices and sub-markets to LBS market, along with, dedicated devices. These include Wireless Communication Technology Chipsets, and Communication Network. Market data for such applications is derived separately and "support tables" of sub-markets (Wi-Fi Chipsets, communication network) are given for reference, along with the dedicated devices and sub-market datasets. Support tables and dedicated market datasets will be compared based on market revenue and growth rate to derive desired insights. Applications such as Wi-Fi based inventory management using LBS, hospital based LBS comes under this category.

Thus it can be said that LBS bounding box includes tightly bound entities such as; Application Software, GPS & RFID tags for LBS, and Service Servers. Loosely bound entities include WLAN/Wi-Fi chipsets and communication network infrastructure.

Each application will be studied separately; research methodology and definitions of LBS for each application will also be provided separately.

MicroMarketMonitor believes that the most prominent segment of LBS is tracking, it contributed largest chunk of revenue in 2013. Tracking can be further segmented in following types:
People tracking (patient, kids), inventory tracking, medical/hospital equipment tracking, vehicle tracking, freight tracking, and so on. Navigation and Mapping segment is ranked second in terms of revenue generation according to this report.

Accordingly MicroMarketMonitor estimates the revenue of LBS through different scenario. For example, the approximate revenue generated from combination of hardware, application software, and services is about $6.5 billion in 2013. The revenue is expected to increase at a double-digit growth rate due to introduction IOT and other new devices supporting LBS.

Location Based Services (LBS) Market considers the market into two geographical segments; Europe and Global wide. Europe Location Based Services (LBS) Market defines LBS "a solution that helps in analysing the information of the location so that it can be integrated with the business processes". While Global Location Based Services (LBS) Market defines LBS as "an information service provided by a device with location details as and when required. When the information is constantly updated

according to the changing location of the device".

According to the provided definition, the global market for LBS is estimated to grow to from $6632.6 million in 2013 to $40464.6 million by 2019, at an estimated CAGR of 37.5%, for the given period. With slightly slower growth, the Europe LBS Market is expected to grow from $2024.2 million in 2013 to $8380.2 million by 2019, at an estimated CAGR of 28.9%, for the given period.

The LBS market is expected to grow further due to availability of low-cost GPS devices, high interest in user's private location information services, and deployment of 4th generation (4G) of mobile network. According to this report, the major areas of opportunities for LBS market are from the navigation, mobile advertisements, tourism, and consumer tracking.

The LBS market are segmented by geographies, products, service, technology, application, and verticals. Also LBS market is segmented based on applications into mapping, discovery and infotainment, business intelligence and analytics, emergency support and disaster management, leisure and social networking, location based advertising, location based games and augmented reality, and tracking. LBS market is also segmented on the basis of different verticals –BFSI, academia and education, healthcare, manufacturing, government and defence, oil and gas, transportation and logistics, media and advertising, and retail.

The Juniper Research's report, "Mobile Context & Location Services: Navigation, Tracking, Social & Local Search 2014-2019", published in Aug 2014, estimates markets context aware apps and LBS. It consider LBS app as all apps, which are geospatially-aware (either on a 2- or 3-dimensional plane), and with the potential of further contexts augmenting the service/user experience. This report considers LBS as any service that use location as part of its function. Based on this, Juniper Research categories all considered LBS applications into following categories:

- Navigational apps
- Social apps; including social media and dating apps
- Tracking; dedicated tracking apps such as family locator, find assets, fitness
- Local search and discovery
- Other; games, augmented reality, entertainment or any other app that uses location as part of its function

Hardware revenues are not considered in the report. Calculations are based on app revenues based on download, post-download or monetisation through in-app advertisements. In this regard, social apps are forecast to account for the greatest revenue.

According to the Juniper Research report, the value of the mobile context and location-based services (LBS) market will more than triple in the next five years. This growth rate is mainly because of the adoption of highly targeted and context-aware ad-supported apps, which will account for over two-thirds of revenues.

The research firm said context-aware and location services will generate $43.3 billion in revenue by 2019, up from just $12.2 billion in 2014 (almost the same values as previously (2009-2014) forecasted by Juniper Research). Juniper Research believes that social apps will be the primary driver of growth in ad-supported revenues related to apps. Local search apps will come in second in terms of ad spending. Over two-thirds of revenues will be driven through highly targeted and contextually aware ad-supported apps by the end of 2019.

In regards of monetization schemes, Juniper Research expects that in-app purchases (IAP) to take off, growing on average more than three times as rapidly per annum as the classic pay-to-download model. According to this report in-app purchases will be particularly prevalent in Navigation, Social and Tracking apps, with consumers preferring the low- to zero-entry cost and developers leveraging Lifetime Value (LTV) rather than one-off sales and consumers are likely to prefer zero or minimal entry costs to participate.

Growing interest in mobile advertising, increase in deployments of Wi-Fi hotspots and Bluetooth low-energy beacons are some of the market drives specially in creating location-based offers targeted at mobile-device users.

The report, "Mobile Context & Location Services: Navigation, Tracking, Social & Local Search 2014-2019", forecasts that the number of smartphone and tablet apps in use, that leverage contextual or location data on devices, will near 7.5 billion by 2019, up from 2.8 billion in 2014. The research highlighted the availability of comprehensive

app-based digital maps, at little or no cost to the consumer, as a key driver. It also noted that context-awareness is now considered to be key amongst app developers in delivering a relevant user experience. According to this report, the use of location and context-driven apps on smartphones will far exceed tablet uptake. Juniper Research believes that cellular network use on tablets is not common amongst consumers, restricting the ability of these devices to take advantage of hyper-local positioning unless connected to public Wi-Fi. Nonetheless, tablets represent a proportionally higher per-app revenue stream relative to smartphones, with higher in-app spends and greater advertising revenue per session.

This report expects that privacy concerns still remain among users, with location to be shared via apps on an instantaneous, rather than continuous basis. Juniper Research believes that ad-supported apps will account for 71% of the total location and context-based service revenue. It also considers the combination of 3G and 4G and the multitude of sensors and data produced by mobile devices as the solution for greater revenue and also as LBS market drives.

- **Pyramid Research**

In a Pyramid Research's report, "Location Based Services Market Forecast 2011-2015", is also discussed here as this report is based on some assumptions, which can be still valid or at least can be easily modified and re-used. For example, it considers growing adoption of GPS devices as a key driver of the LBS market. This assumption (trend) is still valid. The growth rate for adoption of such devices may increase due to upcoming other GNSS systems. According to this report, growing adoption of GPS devices also helps different applications and services to grow. This report includes some suggestions and risk/threat analysis for LBS value chain. As an example, Pyramid Research believes that operators will not have the same control over location information with the growth of other positioning technologies; i.e. in 2008 operators gained around 80% of all location-based service revenue and this had fallen to around half in 2011, but the total market has grown more than fivefold in 2011. It seems that this trend is still valid and Pyramid Research considers this as a potentially important opportunity. It suggests operators to target navigation, local search and people-locating services as they are best positioned and generating more secured revenue. Pyramid Research suggest operators to become more active in theses area by driving their own-branded apps on devices they distribute, maximizing smartphone sales and bundling people-finding services with packages targeting specific segments. According to this report, in-app advertising and advertising-based messaging can also provide some interesting opportunities however they are more limited.

Pyramid Research's report estimates the global LBS market to grow and reach US$10.3bn in 2015, up from $2.8bn in 2010. In addition to growth in adaption of GPS enabled devices, this report believes that success of new business models, continued growth of mobile advertising, and the wider coverage and higher speeds of mobile networks are key drivers of LBS market. According to Pyramid Research navigation is the largest LBS revenue generator while the most aggressive revenue growth rate is for Location Based Advertising (with 60%). The key driver in this segment is development of advertising-funded models and the continued growth in local search.

- **TechNavio**

TechNavio's report, the Global Location-based Service (LBS) Market 2012-2016 forecasts, defines LBS as information services that use real-time geographical data from a mobile device to provide security services, information, and entertainment. This report identifies three user segments for LBS applications: the government organisations, people and consumers, and business enterprises. It categorises the LBS applications into categories of location-based social media, LBA, navigation and tracking, geo-tagging, augmented reality, information services, and emergency services.

According to TechNavio's report, the global LBS market to grow at a CAGR of 35.25% over the period 2012-2016. It believes that the key factors contributing to this market growth is the increasing adoption of GPS-enabled devices. However, the increasing concern associated with personal data privacy could pose a challenge to the growth of this market.

The Global LBS market has also been witnessing the increasing adoption of LBS across various industries. One report studies indoor LBS market in Western Europe. It describes indoor LBS requirements and then forecasts its market, specifically in Western Europe. It limits indoor LBS to a limited geographical area; therefore TechNavio believes that technologies such as WLAN, Wi-Fi, Bluetooth, AGPS, MEMS, UWB, and other hybrid technologies that cover smaller areas can be good solutions for indoor positioning challenge. This reports enumerates some of positioning requirements of indoor LBS, including high accuracy to locate the position of the object. According to this report, increased use of beacons is one of the most important market drives while technology-related complexities is a challenge for many retail enterprises.

All in all TechNavio believes that use of LBS is increasing within many verticals including financial institutions, retailers and marketing networks. TechNavio's analysts forecast the Indoor LBS market in Western Europe to grow at a CAGR of 56.24 percent over the period 2014-2019.

There are other reports, analysing LBS market in North America and Asia pacific. According to TechNavio's report, one of the key factors contributing to growth of the LBS market in North America is the increasing adoption of location-enabled smartphones and tablets. The various location-enabled mobile devices are smartphones, tablets, personal navigation devices (PNDs), and location-enabled devices fitted in vehicles. LBS applications and services are used to track users within wireless network, the Internet and provide search results or relevant information, advertisements, services and suggestions. However, increasing concern for data privacy could pose a challenge to the growth of this market.

TechNavio's report on the LBS market in North America was updated in Aug 2014 and the updated growth rate shows increase in adoption of LBS in different sectors. The report published in 2013 forecasted the LBS market in North America to grow at a CAGR of 24.48% over the period 2012-2016 while the newly published report forecasts the LBS market in North America to grow at a CAGR of 27.05% over the period 2013-2018. This shows increase in adoption of LBS applications, services and devices by different user segments even more than what is was expected to be.

According to TechNavio's report, the LBS market in North America can be segmented into two: Indoor LBS and Outdoor LBS. In terms of end-users, the market is segmented into three: Individual Consumers, Government Organizations, and Small and Medium-sized Enterprises (SMEs) and Large Enterprises. The outdoor LBS segment is sub-segmented into seven: navigation, location-based search and advertising, location-based

infotainment, tracking, location-based analytics, location-based fitness and wearable applications, and others.

According to a TechNavio's report, the LBS Market in APAC to grow at a CAGR of 33.20% over the period 2014-2019. This Report classifies the LBS market in APAC into two major segments based on Usage and Users. On the basis of usage, the market is segmented into two categories: Indoor LBS and Outdoor LBS. On the basis of outdoor LBS services, the market is segmented into four categories: Location-based Search and Advertising, Location-based Tracking, Location-based Navigation, and Location-based Infotainment and Analytics. On the basis of users, the market is segmented into three categories: Individual Consumers, Enterprises, and Government Organizations.

This report considers increased adoption of location-enabled devices in APAC as a key market driver, which results in increased adoption of location-based in many sectors specifically in location-based search and advertising. However this has encountered some challenges including lack of knowledge of LBS among consumers.

TechNavio's report identifies the following companies as the key vendors of LBS: Foursquare Labs, Google, TeleNav, TomTom. This report the E911 mandate for emergency services is the most important market driver while the concern over data privacy introduces the biggest challenge to the market of LBS. All in all, the trend shows a growth in use, particularly in popularity of Location-based Games among youth.

- ▪ **ReportsnReports**

ReportsnReports published a market study on the global LBS Market in Healthcare Industry 2015-2019. It expects a globally growth in the adoption of location-based applications, in the Healthcare Industry to grow at a CAGR of 31.23% from 2015-2019. It defines LBS as information service that uses real-time geographical data from a location-enabled device to provide security services, and information. This report understands that LBS applications are predominantly used in hospitals to improve efficiency and reduce expenditure. The use of Wi-Fi and RTLS technology in indoor locations can help LBS to be used in hospitals for indoor navigation, tracking staff and patients, location-based messaging, asset management, location analytics, and in integrating with other clinical systems.

ReportsnReports identifies that the Real-time performance monitoring (RPM) has been gaining popularity in the healthcare industry, as it assists both patients and doctors, and helps increase hospital efficiency. This report understands that in 2014, around 10 million units of wearable devices were sold worldwide and this number is expected to grow nearly tenfold in the coming years. The constant use of wearable devices, in the healthcare industry is anticipated to reduce hospital costs by a significant amount over the next six years. Additionally, many hospitals are incorporating data analytics software for tracking hospital resources and monitoring patients. Advanced analytics will help hospital staff collect large data sets, extract real-time information and make better decisions when maintaining medical equipment, thus positively impacting the Global LBS Market in the Healthcare Industry.

An LBS platform consists of software and hardware extensions as well as network infrastructure components in the network infrastructure, which can calculate the position of a handset. The major components of an LBS platform are location platform and infrastructure providers, location middleware providers, location technology developers, GNSS chipsets and assistance server providers, location platform

aggregators, and database providers. Apart from these, a LBS platform also provides for commercial use in location-based advertisements, location-based searches, indoor positioning, and location-based analytics.

Analysts forecast the Global LBS Platform market to grow at a CAGR of 19.53% over the period 2013-2018. The Global LBS Market in Healthcare Industry 2015-2019 report has been prepared based on an in-depth market analysis with inputs from industry experts. The report covers the APAC region, the EMEA region, Latin America and North America; it also covers the market landscape and its growth prospects in the coming years. The report also includes a discussion on the key vendors operating in this market.

This report identifies following companies as the key players of the health LBS market AeroScout, Awarepoint, Ekahau, GE Healthcare, Hewlett-Packard Enterprise Services and Zebra Technologies

- **Global LBS Platform Market 2014-2018**

The Global LBS Platform Market 2014-2018 covers the Global LBS Platform market landscape and its growth prospects in the coming years. This report includes a discussion of the key vendors operating in this market. According to the Global LBS platform market report, one of the emerging trends in this market is an increase in the use of LBS for public safety and national security as most government organizations and security agencies use this platform to trace the location of emergency callers.

According to the report, one of the main drivers in this market is the integration of mobile advertising and LBS. Most of the businesses use location-based mobile advertising to advertise their products and to provide the right information at the right time and at the right place to consumers.

- **Global Consumer LBS Market 2014-2018**

According to the Global Consumer LBS market report, the consumer LBS market grows at a CAGR of 37.38% over the period 2013-2018. This report categorises the consumer market based on the application into segments of navigation and tracking, travel and tourism, social networking, family finder, location-based gaming, health and fitness, and weather information. It forecasts that the global indoor LBS market to grow at a CAGR of 49.42% over the period 2013-2018.

To calculate the market size, the report considers the revenue generated from the following revenue streams: licensing of indoor LBS software, applications, middleware, and platforms, annual sales of devices used for indoor LBS, indoor LBS maps and navigation, tracking, monitoring, emergency services, and analytics, and LBS search and advertising revenue

Indoor LBS used in commercial buildings, government offices, and important buildings as well as the Public Safety and Security, Education, Healthcare, Travel and Hospitality, Manufacturing, Logistics and Distribution, Oil and Gas, and Mining industries. This report expects a third of SMEs (35%) are using digital mapping for location-based marketing (LBM), with an additional 19% of SMEs to take up these services during 2013 (this would bring the total to 54%, close behind the 56% of corporates expected to be using such services by the end of 2013).

- **LBS Market Forecast: Forecasting as a Process**

A market forecast is a core component of a market analysis. It projects the future numbers, characteristics, and trends in the target market, here LBS market.

2.1   Preliminaries and concepts

A *forecast* is a statement of what you think will happen, based on certain assumptions about the world – assumptions about the external environment and about future actions of plays (of the market). In other words, forecast is a likely future actual outcome or a description of where we think we are heading, based on current assumptions . In the context of business forecast, the assumptions used to produce a forecast will include those about the business environment, the likely future impact of things that weren't in the past, the things that are planned to do in the future.

A *target* is a description of where an environment, business or players would like to be. Obviously targets and forecasts are not the same. A forecast is what the future will look like, while a target is what the future should look like.

A *plan* is a set of related future actions design to reach an objective. A plan is a set of actions, which can but need not necessarily be quantified. *Planning* is the process of defining a set of future actions with the aim of achieving an objective.

The future always has two components: trends and discontinuities. Although any market including Location Based Services market is nonlinear, it can be assumed that within limits (such as time limit or market size threshold) it behaves stable enough to be considered as a linear system. This makes it possible to identify some patterns (of past behaviours), which repeat themselves. Such trends are essential for future market forecast and without them forecasting would be possible at all. Up to some extends, trends are forecastable (depending on the modelling techniques being used) however future is not always like the past. Discontinuities (or according to econometricians, "structural breaks") are such occasions when trends change or stop. Discontinuities are those occasions when future is not following trends; it can be due to novelty or just discontinuities of previous trends (some time because of some reasons out of the market such as upcoming a replacing product or technology). The market analyser cannot forecast what would be the future novelty, however the likelihood of such discontinuities should be estimated or at least considered.

- **Impact estimation and forecasting models:**

Input-Output (IO) model has been the most widely used methodology for impact estimate. The popularity of IO models for disaster related research is based mainly on the ability to reflect the economic interdependencies within an economy in detail for deriving higher-order effects, and partly on its simplicity. The simplicity of the IO framework has enabled integrative approaches, in which IO models are combined with engineering models and/or data, in order to estimate higher-order effects that are more sensitive to the changes in physical destruction. Some examples of this approach include the links with transportation network models (Gordon *et al.*, 1998, 2004; Cho *et al*, 2001; Sohn *et al.*, 2004, among others), with lifeline network models (Rose, 1981; Rose *et al.* 1997; Rose and Benavides, 1998), and the comprehensive disaster assessment model, namely HAZUS (Cochrane *et al.*, 1997).

On the other hand, this simplicity of the IO model creates a set of weaknesses, including its linearity, its rigid structure with respect to input and import substitutions, a lack of explicit resource constraints, and a lack of responses to price changes (Rose, 2004). In order to overcome these weaknesses in a disaster situation, several attempts of refinement and extension of the IO framework have been proposed. For instance, the shortage of regionally produced inputs in a disaster situation was dealt with by the integration of a methodology for more flexible treatment of imports (Boisvert, 1992; and Cochrane, 1997). The issue of supply-side constraints due to the damages to production facilities was addressed with the allocation model variant of IO model (Davis and Salkin, 1984); however, this modeling scheme has inherent deficiencies (Oosterhaven, 1988 and 1989; see Dietzenbacher, 1997, for a solution), and was later modified by Steinback (2004) to include only backward-linkage effects. The treatment of price has been transferred to computable general equilibrium (CGE) models.

The input-output (IO) framework was developed by Wassily Leontief in the late 1920s and early 1930s. The structure of IO mimics the double-entry style of bookkeeping scheme. For the production side, the output is determined as the sum of intermediate demand and final demand.

Other modelling frameworks have been also employed to estimate higher-order effects of disasters. Social accounting matrix (SAM) has been utilized to examine the higher-order effects across different socio-economic agents, activities, and factors. Notable studies using a SAM or one of its variants include Cole (1995, 1998, and 2004) among others. Like IO models, the SAM approach has rigid coefficients and it tends to provide upper bounds for the estimates. On the other hand, the SAM framework, as well as extended IO models[2] and CGE models, can derive the distributional impacts of a disaster in order to evaluate equity considerations for public policies against disasters.

SAM was developed by Stone (1961) and further formalized by Pyatt and Thorbecke (1976) and Pyatt and Roe (1977) for policy and planning purpose. SAM is an extended version of IO (and more closely to Miyazawa formulation above), and the structure of a typical SAM is shown in Figure 2-1[3]. Similar to IO analysis, the accounting multiplier matrix can be derived in the following way.

The assessment methodology used in the above reports is mostly based on the ECLAC methodology (UN ECLAC, 2003), except the 1995 Kobe Earthquake. ECLAC methodology classifies the damages and losses from a disaster into: a) direct damages (damage to asset); b) indirect losses (loss of flows for the production of goods and services); and c) macroeconomic effects (effect to the performance of the main macroeconomic aggregates of the affected country) (p. 9). Since this paper aims to estimate and to demonstrate the methodology for the higher-order effects of a disaster, _macroeconomic effects', such as impact on investment, balance of payment, finance, and inflation, are not accounted for in the following analysis. In addition, the ECALC methodology and the

assessment reports include the damages and losses on _environment.' While the impact to environment can lead to economic impacts in many ways, the data for model used in this paper, IO and SAM, do not include impacts on the environment. Thus, the damages and losses on environment are excluded in the following analysis.

- **LBS Market Challenges and Issues**

  o **Seamless positioning**

The indoor positioning is the needed capability for many LBS applications. Some industry analysts believe that indoor localisation may need some major technology improvements. They also thinks that for many LBS applications, which need indoor positioning service as an input, the technology hasn't developed fast enough. A continuous and cheap (ideally free of charge) positioning service which can provide a meter level (or ideally less) accuracy inside houses, shopping centres, offices and airports is needed for many applications. Acceptable indoor positioning can improve indoor LBS market from two sides; more frequent use (indoor and outdoor) of current LBS applications, and also having new indoor-specific applications addressing indoor-specific challenges and needs.
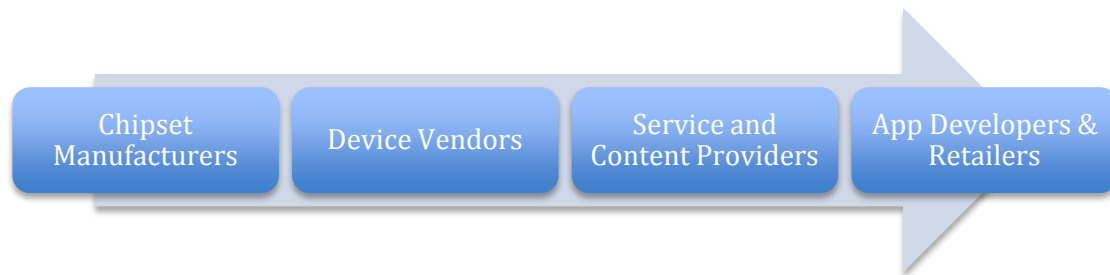
  o **Privacy**

According to published reports, South Korea sent police into Google's Seoul office this month to examine how the company's AdMob platform and Android devices can collect private data about user's location. Google purchased AdMob last year for $700 million.

In France, companies with GPS-enabled devices are required to turn the systems off during an employee's personal break, said lawyer Francoise Gilbert, in a privacy session at Where 2.0. "There is a significant difference in laws [overseas]. One size doesn't fit all," she said. "It is a bad idea to talk to your lawyer the day before you plan a product or website launch."

In addition, at Where 2.0, the American Civil Liberties Union had a speaker and booth on site to educate developers on privacy issues. The ACLU was promoting its 2011 Privacy Challenge for developers of smartphones and other applications.

4.   LBS Value Chain

The value chain for LBS can be shown in the diagram below.

Chipset Manufacturers	Device Vendors	Service and Content Providers	App Developers & Retailers

- o   Chipset Manufacturers

The latest developments in position chipsets are around using multiple satellite position networks (e.g. GPS (USA), GLONASS (Russia) and Galileo (Europe)) and linking with other sensors in the devices, such as Inertial Measurement Units (accelerometers, gyroscopes and compasses). Using other external location sources is also being integrated, such as the use of WiFi locations.

There are four main aims to developments in this area:

1. Improved position accuracy
2. Reduced time to first fix
3. Reduce power consumption
4. Indoor/seamless navigation

It is not anticipated that all of these can be achieved at the same time. For example, if power consumption is the most important factor, accuracy of position could be reduced.

- o   Device Vendors

GNSS1 positioning is now standard in smartphones, fit bands and many other personal devices such as cameras.

The market is highly competitive and device manufacturers and vendors are seeking any advantage in the market place. Many are starting to add Location Based Services as a differentiator.

Intelligent Personal Assistants are now included in all major smartphone operating systems. Apple has Siri, Google has Google Now and Microsoft has incorporated Cortana.

One of the major research areas for location is indoor positioning, leading to seamless navigation from GNSS though buildings to your final destination. Many systems are being developed to create indoor positions from location beacons, wifi signals, visual tags and GNSS extensions. This is potentially a very large market opportunity.

- o   Service and Content Providers
- o   This part of the market is showing great innovation and new apps are being developed that have a novel use for location. As Study by INS Globali

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[1] GNSS – Global Navigation Satellite Systems, which is the generic name for systems such as GPS, Galileo and GLONASS.

showed that the largest proportion of people were using their location for navigation followed by roughly one-fifth using it for finding friend, restaurants or public transport

o Augmented Reality

o Augmented reality offers new interactions with our environment. By understanding our position, we can overlay new feature through our connected devices. These may be games or tourist information or a range of other infotainment.

o App Developers and Retailers

o Many retailers have developed or had developed their own apps for smartphones. At the very least, these include a 'find nearest store' option. An increasing trend is for geofencing adverts. This is where adverts and offers are pushed to a users device when they are within a defined geographical area.

o The market here can be split into two areas. The first is the revenue that the app developers generate from creating the app. The second is the additional revenue that the retailer receives as a result of the app. It is not known how this latter market could be measured.

Conclusion

LBS market development has faced several challenges including the availability and reliability of indoor positioning technologies, privacy issues, availability of content. However there is a general growth in the market size and segments according to most of market reports and research papers reviewed in this report. The details of future directions are discussed in deliverable 2.13.