Routes to Market Report

21 – Satellite Technologies for Location Based Services

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Satellite Applications

Contents

1. Introduction and Scope

The General Space Technology of relevance to Location-Based Services is Global Navigation Satellite System (GNSS). More commonly known as 'satellite navigation' (often abbreviated to 'satnav', or more simply 'GPS'), GNSS is an umbrella term describing an infrastructure that provides positioning, navigation and timing (PNT) information via satellites, supported by a ground segment. This utility allows users with a compatible receiver to determine their position, velocity and/or precise local time by processing signals received from satellites orbiting in space.

Location-Based Services (LBS) comprise all services that are enabled or significantly enhanced by access to the user's location information. LBS are agnostic to the source of location information, but in practice GNSS is currently the primary source of location information, often supplemented by other services such as Wi-Fi, Cell ID, Bluetooth and many others. LBS are used globally across a wide range of consumer and professional applications. LBS can be broadly separated into outdoor and indoor services. Outdoor LBS are based on GNSS (and additional technologies) while indoor services tend not to use space-relevant technologies and is therefore outside the scope of this briefing.

LBS is primarily a consumer/mass-market segment, and most often thought of as location services through applications on a smartphone (e.g. maps), but LBS are equally relevant for tablets, fitness watches, and point-of-interest navigation, e.g. finding the nearest petrol station, in vehicles using in-built (In-Vehicle-System – IVS) or handheld (Portable Navigation Device – PND) navigation equipment in cars, and many other devices. In addition, tracking applications comprising children, pets, luggage, dementia patients, lone workers, etc. are considered in scope for LBS. Asset tracking is an application of Internet of Things and not in scope.

Both hardware and software are in scope of this market briefing, including the chips and devices, subscription services such as monitoring of tracking of dementia patients and software, including mobile applications.

This Market Briefing has global coverage, and covers all markets of relevance, but applications related to the Internet of Things are not in scope (covered in a separate Market Briefing). Military applications intended to rely on the Public Regulated Service from Galileo are also not in scope (covered in a separate Market Briefing). Location-based services from autonomous vehicles are not in scope either (covered in a separate Market Briefing).

This Market Briefing covers 2016-2020 (near term) and extends to 2030 (longer term).

2. Market Overview and Opportunities

As almost everyone has access to location information through their smartphone, LBS is probably the most proliferated instance of use of a space service in the world, but due to its commodification, LBS is not widely considered a space or satellite service.

The value chain for LBS starts at space manufacturing, where GNSS satellites and ground infrastructure are built and launched. In the space operations segment, GNSS satellites and ground segment are

operated. By far the largest space value chain segment for LBS is space applications. Space applications is further segmented into manufacturers of GNSS chips and receivers, system integrators and providers of software and added-value services.

2.1. Space Manufacturing and Operations

LBS-relevant space manufacturing and operations are GNSS infrastructure. GPS, GLONASS, and BeiDou are all foreign, military systems, and the potential for UK companies to capture any meaningful share of the market for modernising these constellations seems limited. Galileo is a European system, which has already awarded significant contracts to UK entities.

LBS does not require separate GNSS satellites or payload, and this Market Briefing therefore only considers the Space Applications segment.

2.2. Space Applications

Hardware

The development of chips for the devices that have traditionally been used for location-based services is concentrated in few major fabless semiconductor companies, none of which are UK held, but the majority have significant UK presence.

For the traditional LBS devices, antennae are integrated on the same chip, and therefore not a separate market. However, for the peripheral LBS devices, such as In-Vehicle Systems (IVS), GNSS information is received using an antenna that is housed in the same piece of equipment that houses the broadcast radio antenna.

Software

The greatest market potential is in the software domain, covering software for the chip itself (of minor value), and the mobile applications available from the various application stores for smartphones, tablets etc.

In 2016, the total global revenue from app sales, in-app-purchases and advertising exceeded $17bn from location-aware apps, showing a significant potential.

Location-aware apps can be considered in five different groups: navigation, social, tracking, search, and games (including augmented reality, such as Pokémon Go). The degree to which each category of app relies on location information varies from social apps (e.g. Twitter/Facebook/ Instagram/…), where location information is of limited importance to navigation apps (e.g. turn-by-turn navigation from Google Maps/Waze/TomTom/…), where location information is crucial for the app to function.

Mobile subscriptions

In addition to the core LBS market described above, revenue is generated in the mobile telecommunications industry, where ABI Research estimate that 13% of mobile data is used to run location-based services on mobile phones.

3. Customer and value proposition to the customer and end user

LBS is primarily a consumer/mass-market segment, so customers of LBS are private citizen users, including consumers using LBS in their leisure time, but also professional users such as minicab drivers. In general, consumers are not aware of how their device derives location information, but consider it to be one of many services that are accessible from their handset.

The hardware decision to use LBS is made by few manufacturers of handset, but GNSS is fully implemented in smartphones, and has been for many years so consumers do not have a real option to de-select the functionality in their device. On the other hand, apart from few pre-installed apps (e.g. Google Maps or Apple Maps, etc.), consumers have full discretion over the choice to use additional services, whose offerings are set to improve. The recent Android Nougat operating system (OS) has released the GNSS pseudoranges, which could result in better software – especially if Apple and other mobile OS developers follow the same approach.

4. Market Competition

The use of LBS is driven by a desire for efficiency and convenience.

Turn-by-turn navigation apps enable faster, less stressful and generally better experiences for car and pedestrian navigation while point-of-interest searches such as "nearest Indian restaurant" makes it possible for consumers in unfamiliar surroundings to have better experiences through more diverse offerings and by "escaping tourist traps" if they so desire.

Users of sport and fitness applications either through smartphone or dedicated devices can monitor their exercise better, and derive pleasure and assurance that they complete pre-set targets. In some cases, health insurance providers will reduce the premium or offer other benefits to customers that complete such targets.

LBS also encompasses tracking applications that let parents know where their children are, and enable next of kin to track dementia patients, and give them peace of mind or the ability to intervene effectively if something is wrong.

In the main, LBS are provided free of charge to the end-user, but terms and conditions of usage include the user surrendering the location information (and other details) to the service provider, who can use the information for targeted advertising, market intelligence gathering, or by selling it on.

Applications using GNSS therefore do not always incorporate the functionality for the benefit of the user. Location-based advertising is an application of GNSS and LBS that has been touted for several years. Many retailers offer apps to customers for convenient online shopping, and using the information stored in the application, could be interested in sending push messages to customers as they pass physical shops. However, the role of GNSS in such applications might be limited as the location accuracy from GNSS-only would be insufficient and Wi-Fi or Bluetooth would probably be used instead. Similarly, the poor performance of GNSS indoors would also rule out the technology from tracking customers inside a shop.

5. Role of UK Companies

Consumers have no choice over whether they derive location from GNSS or other sources. Developments in the domain, such as 5G, could reduce the demand for GNSS, but software developers only require location information to be able to serve their customers and will therefore not be affected by a transition at the hardware level.

6. Revenue Projections

Many UK companies are active in the LBS domain. Chipset, handset and other device manufacturers, while not UK-owned, have significant presence in the UK (e.g. Qualcomm, Broadcom, Mediatek, Samsung, Apple, Intel, Google, Garmin and many others) and software developers and service providers (UK and non-UK held) are also widely represented across the value chain, including start-ups developing chip-level software to improve accuracy, food delivery and minicab services, and a wide variety of other providers.

LBS is a large, lucrative global market that is forecasted to continue to grow strongly out to 2030. With growth being driven by evolution rather than revolution, the opportunity for UK-based organisations is to maintain and grow the UK's share of this growing global market.

Global	2016	2017	2020	2030
Hardware revenues	€2.7bn	€3.0bn	€4.4bn	€5.8bn
Software revenues	€5.0bn	€6.6bn	€13.6bn	€51.4bn
Data revenues	€40bn	€45bn	€70bn	€100bn

6.1. Global revenues

Hardware revenues only relate to the value of the GNSS chip and mobile data revenues are limited to those used to run location-based applications (both sourced from ABI Research).

Only software revenues *attributable to location information* covering navigation, social, search, tracking, and games applications for smartphones (sourced from Juniper Research) is considered. I.e. the total revenue from location-aware applications (app sales, in-app-purchases and advertising) is much greater (€38bn in 2020), but the majority of this is beyond the scope of a space-anchored market briefing.

In principle, all the **software** revenue is addressable for UK companies as apps can be offered globally at the click of a button, and any apps that fill a gap or solve a problem can reach global penetration in a short space of time (as illustrated by the case of Pokémon Go, although this particular app appears to have lost its appeal again). However, large industry players such as Google will continue to capture a significant part of the market. With a declared ambition for the UK space industry to derive £1bn of revenue from LBS in 2030, the overall size of the market (and existing successes such as Deliveroo turning over £130m in 2016) suggest the ambition is highly feasible.

At present, the **hardware** market is highly consolidated, with few, large chipset manufacturers dominating the components and receiver market. Further downstream at the device level, the large markets such as smartphones are dominated by Asian and US companies, but niches are addressable for all companies. The personal tracking market for example remains largely unconsolidated, so development of a superior or cheaper, disruptive, product could see new companies capture significant market shares.

An additional source of revenue relates to the data revenues generated by mobile telecommunications companies, explicitly for running location-based services such as maps, weather forecasts or location-enabled dating services (e.g. Tinder). ABI Research estimate that 13% of all data downloads from mobile telephones are used for location-based services, implying an LBS-induced World market of €40bn in 2016. At 91m, the UK accounts for approximately 2% of global smartphones, implying approximately £750m addressable for UK telecoms operators through domestic operations. A greater amount will be addressable for the international operations of UK companies. Vodafone, for example, had 337m non-UK subscribers in 2016, according to Statista.

7. SWOT Analysis

7.1. Position Navigation Timing (e.g. GPS, Galileo etc.)

| Strengths | UK presence of leading GNSS players
Supportive UK policy and support environment for downstream applications
Access to all GNSS signals, including Galileo
UK participation in ESA Navigation programme
Generous R&D funding in UK, Europe
Expertise in testing and GNSS resilience
GNSS payload manufacturer (SSTL) |
|---|---|
| Weaknesses | Lack of downstream hardware manufacturers (owing to cost)
Risk appetite |
| Opportunities | High growth market
Developments of modernised GNSS constellations offering improved performance to expand offering to additional applications
Dynamic market
Galileo Open Service (OS) Authentication |
| Threats | BREXIT and continued access to Galileo, European funding programmes
Skills shortage in application development
5G and quantum inertial sensors *may* relegate GNSS from preferred location provider in the long term, transferring the market out of the space industry. |

8. Opportunity Blockers

Continued support for app and hardware developers to enable them to reach maturity.
Ease of hiring talent independent of origin.

Develop a more holistic approach to LBS, not considering the market purely space/GNSS but acknowledge the contribution of alternative sensors, which may make indoor positioning more accurate and better within a few years.

By value, the largest LBS companies are successful app developers such as Google, Apple, and similar multi-stranded technology companies. The absence of UK headquartered software giants means that spin-outs from established companies is relatively less frequent than in other countries, most notably in Silicon Valley in the US.

Galileo, Europe's GNSS, will offer an Authentication service on its Open Service (OS). Authentication of the signal enables the user to verify that the signal comes from a satellite in space as opposed to a local spoofer. GNSS spoofing has gained increased attention recently as players of Pokémon Go realised that better Pokémon spawn in areas of high population density (allegedly, Central Park in New York City was the best location). Players based in rural areas therefore began to explore ways to cheat their phone into believing they were in Central Park instead. At the software level, applications exist that can override the GNSS information on the phone and replace it for a convenient location, while specific hardware that can broadcast chosen signals mimicking those from GNSS satellites, although illegal, is widely available on the Internet.

OS Authentication from Galileo will make app developers able to add a layer of security to add confidence that users are where they claim to be. A common property of applications of OS Authentication is that users could benefit from pretending to be somewhere they are not. From an LBS perspective, this includes Digital Rights Management, where OS Authentication can ensure that consumers of digital content such as BBC iPlayer are in fact in the UK and not using a VPN connection from abroad. Similarly, online gambling rules may differ between countries (e.g. in terms of tax levied), which may incentivise users to pretend to be somewhere else. Credit companies may also use OS Authentication in the future to ensure that transactions (physical or online) are taking place from the same location as the user's registered phone. OS Authentication is well-defined and will be added to the Galileo services offering before Full Operational Capability is reached in 2020.

UK companies are well placed to develop applications to take advantage of OS Authentication, either through national R&D programmes and incubators or ESA-level activity.

9. Market Dynamics

The stakeholders in the LBS market should be considered separately for hardware and software companies. At the chip level, the market is heavily concentrated with three companies accounting for more than 90% of the market (Qualcomm, Broadcom, and Mediatek) with a handful of smaller companies making up the rest. Manufacturers of consumer equipment is also concentrated, but to less degree. Handset manufacturers Samsung, Apple, Google, HTC, etc. make the decision to include GNSS in their phones (and have all chosen to do so). For other devices, Garmin, Polar Electro and others have major roles, but other manufacturers in niche markets such as tracking of dementia patients also play a role.

For software, the market is influenced by large companies such as Google, Uber, and Apple, but many smaller companies including Deliveroo, which already generates more than £100m worth of annual revenue, as well as similar types of businesses.

Hardware supply chains do not generally involve UK companies, but are concentrated in Asia, where most manufacturing occurs. Many of the developers of hardware do, however, have UK activity and R&D centres.

10. Market Trends

Supply chains are subjected to limited regulation (although both China and Russia mandate the use of own GNSS on devices sold on home soil).

Supply and value chains for hardware are increasingly consolidating with the main equipment manufacturers acquiring related companies, e.g. Qualcomm's recent acquisition of CSR.
The market is sustainable and has grown at more than 30% p.a. over the last three years.