

Personal Navigation Markets in Europe

Pre-study

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Executive Summary

This section highlights the main conclusions from each separate section.

The European Market: Statistics and Analysis

In Europe, there is less emphasis on security and emergency services than in the US. There is no government mandate for emergency services as there is in the US. Hence, the focus of location-based services in Europe can remain commercial. European mobile operators believe that the European market is geared more towards applications.

The Strategis Group believes that the markets in Western Europe generating the most location-based traffic in 2007 will be: Germany, the UK, France, Italy and Spain. However, this does not reveal how advanced certain markets are. In Switzerland, for example, all three operators offer location-based services and the first ones were introduced as far back as December 1999. Information browsing is projected to account for almost half of all location-based traffic in 2007. Such a projection, however, does not take into account that "mobile communities" applications like "Friend finder" are experiencing a steep climb in popularity.

A-GPS sales will only begin in 2004 and might double by 2007 to 6.3 million handsets sold annually. Sales might be much higher if mobile operators leap from cell-based positioning methods to GPS, foregoing the opportunity to implement E-OTD technology.

Location-based services can be classified according to nine types:

1. Local information
2. Navigation
3. Mobile communities
4. Gaming
5. Commerce
6. Security
7. Resource management
8. Emergency services
9. Local billing

Mobile Operators in Europe

The degree of sophistication of a mobile operator's location-based offering can be evaluated. This is done by considering the number of types of services offered. The following mobile operators show a high degree of development. They cover three services categories.

- Deutsche Telekom, E-Plus, Swisscom, and Vodaphone - Local information, Navigation, and Mobile Communities
- Radiolinja - Navigation, Mobile Communities and Resource management
- Telia - Local information, Navigation, and Gaming

Orange is the only operator to cover four categories, and is the most advanced. Its service categories are: Local information, Navigation, Gaming and Emergency services. The inclusion of Emergency services, a type of service expected more in the US, is an interesting development. In the future, the Europeans may adopt more such location-based services, along with ones falling into the Security category.

By the end of 2002, about 40 mobile operators will be offering location-based services to their mobile subscribers. The competition will be intense and location-based services will be a feature of everyday mobile life.

Content and Service Providers

Content and service provision can be classified according to six categories:

- Mobile Communities
- City Guides
- Directories
- Games
- Travel
- Map Data

The differentiation of location-based services with content is likely to attract new users. It is not always necessary to provide extensive up-to-date content to create a winning service.

In the Mobile Communities area, very little content is required to make an application successful. A good example is "Friend finder" applications. Such applications are aimed at the youth segment and reinforce the notion of convenient communication amongst peers. However, such services rely on location "pings" when someone is positioned. The price of positioning someone at the present time may simply be too great for users to pay for it frequently.

GPS Receivers, Add-ons for Mobile Phones and PDAs

We are on the threshold of widespread adoption of GPS technology - for mobile phones, PDAs and even watches. Garmin is launching its NavTalk II phone in the very near future, upsetting Benefon's dominant position in Europe (Mar 2002). SiRF Technology is forming an alliance with Motorola for the integration of SiRF's GPS technology into its iDEN(R) family of digital wireless phones (Mar 2002). As if that was not enough, Sony Ericsson is introducing the T206 (Mar 2002) in the fall, featuring GPS for emergency and location-based services.

In addition to these GPS phones, there is now a range of GPS add-ons for standard mobile phones. In the US, Airbiquity is providing an add-on for Nokia phones. Chapman technologies is developing its GPS add-on for Ericsson's new T60c mobile phone. Shipments of the updated Nokia 9210i Communicator are expected to begin in Europe and Asia in Q2 2002. With the addition of a new GPS add-on, the Nokia Communicator is also moving into a new phase

All these developments taken together will encourage mobile operators to consider the evolutionary path for positioning technology. They may leap from Cell-ID methods straight to the adoption of GPS, foregoing E-OTD completely.

Location Technology Developers

GPS handset based solutions are now beginning to demand serious consideration from European mobile operators. Many European operators are asking whether it would be best to implement GPS technology straight after the Cell-ID stage. This would make E-OTD technology redundant. In practice, many operators will adopt a "wait-and-see" policy until the market situation is clarified.

Whatever the fate of E-OTD technology, the future is bright for "middleware" and location-based applications vendors. Middleware technology is designed to interface with any positioning technology, whether it be network-based or handset-based. LBS applications vendors are similarly well placed.

Vehicle Navigation

Car buyers are not willing to pay for expensive embedded safety hardware and services that they hope will never get used. Luxury car buyers may be able to justify the purchase of such equipment, but it is unlikely to influence their decision to buy a particular model in the first place.

After-market installations are fond of pairing in-car navigation with entertainment. In the mind of the buyer, the fact that a navigation system comes with in-car entertainment may justify its purchase.

Yeoman's package offers in-car navigation on standard mobile phones in the UK (Dec 2001). Though it promises turn-by-turn navigation, GPS accuracy is missing, and it may be ineffective in practice. The Siemens GPS add-on for its phones may provide the necessary accuracy for turn-by-turn navigation, but may be difficult to operate. Driver distraction is an increasingly heated topic that will not go away.

PDA's with GPS add-ons are likely to become the most popular choice. Small, portable and powerful technology has always held great appeal. Combining PDA devices with the precision of GPS represents a natural progression. Users can plan their trip, customise maps and directions, and track their progress - at the office, on the move, or in the car.

Fleet Management and Tracking

In the B2B sector, fleet management applications are finding success largely because trucking organizations have infrastructure that supports the telematics services. Location-based companies in the fleet management area can be divided into two groups: applications and solutions. Solutions generally include a package of software and hardware.

There is growing interest in the area of tracking in Europe. These services are categorised as Security ones. Tracking people, pets and objects are all possible with GPS. Digital Angel, Tracker, Trackwell and ULTRACOM all serve the European market. The rise in popularity of such services will depend on how successfully they are marketed.

Indoor Positioning

A-GPS (Assisted GPS), E-OTD (Enhanced Observed Time Difference of Arrival), and TDOA (Time Difference of Arrival) do not address the issue of highly accurate positioning for use indoors. Since these technologies do not address three-dimensional positioning either, in multi-story buildings they may provide grossly inaccurate positioning information.

Much better accuracy (1-3 metres) will be required by indoor applications. To fulfill this need new technologies are evolving rapidly. These include: WLAN, Bluetooth, Digital Television, RFID (radio frequency identification), indoor GPS, infra-red, and ultrasonic positioning. The newest of these techniques is Digital TV positioning, pioneered by US-based Rosum. This technique can also be applied to digital television standards in Europe. However, it is much too early to predict a technology winner in a market in its infancy.

European Research Activities

There are a number of projects relating to the positioning technology infrastructure in Europe. In particular, two projects warrant more attention than the others in this area - CGALIES and GALILEO. CGALIES is defining requirements for a pan-European common location provisioning mechanism that can be accessed and used by the European 112 community. There is no government mandate for emergency services as there is in the US. Hence, the focus of location-based services in Europe can remain commercial.

The GALILEO project is another pan-European project based on GPS technology. It intends to enable each European citizen to know his or her position to within a few metres. With the support of the European Space Agency it aims at launching a series of satellites. There will be three levels of service: basic, subscription, and high-level subscription.

Transport and tourism is also a focus of attention at the European level. Tourism is one of the major European economical, cultural and social enterprises. However, information and support services for tourists are often inadequate. Several projects are operating to fill the vacuum. There are also projects in the area of info-mobility.

The European Market: Statistics and Analysis

This section takes a look at the relevant statistics for location-based services in Europe and offers an interpretation of them.

Europe in Perspective

To the present day, safety remains a principal reason for purchase of a mobile phone in the US. In addition, the regulatory environment emphasises the importance of accurately locating a mobile phone in the event of an emergency. The situation is very different in Europe. While the US may be the leader in developing high accuracy location technologies to support the mandated E911 wireless emergency services, Europe has been quicker in implementing commercial location-based services. Without a government mandate like in the US, commercial considerations will continue to come first in Europe.

European mobile operators believe that in a market geared towards applications, developing services with location as a key feature will enable the generation of new revenues. It is not surprising therefore, that most European operators have launched location-based services in one form or another. The present study names the operators who have launched such services. There will be more following suit in the next year or so.

It would also be helpful to categorise location-based services according to type, with reference to the apparent emphasis in European markets. Some categories reflect an American influence, and services falling into these categories are less likely to make their mark in Europe at the present time, though this could change in the future. In particular, the categories of security and emergency services are more applicable in the US. Many of the categories refer to services of more or less universal appeal amongst adults: local information, navigation, and resource management. Two categories, mobile communities and gaming, are expected to appeal predominantly to teenagers on both sides of the Atlantic.

Service	Description
1. Local information	Nearest services, guides, phone numbers, and booking
2. Navigation	Route direction, traffic updates, and public transport
3. Mobile communities	Share my position with colleagues or friends, and interact
4. Gaming	Playing location-based games
5. Commerce	Permission based SMS, m-coupons, and special offers
6. Security	My position, my children's position, and my car's position
7. Resource Management	Field staff management, logistics, assigning resources
8. Emergency services	E911 mandate in the US, similar legislation for the EU?
9. Local billing	Billing dependent upon location: at home, work, on the move

Availability and Usage

How widespread will location-based services become, and how often will they be used in Europe? The Strategis Group has produced some statistics (Oct 2001) that give some idea as to the number of potential users of location-based services. It believes it makes most sense to calculate the number of mobile phone users with access to location-based services, and the number of location requests they are likely to make. This does not therefore reflect the number of users actually using the services. Hence, the statistics can only provide a rough guide to actual usage in the location-based services domain.

It is forecast that the number of mobile phone users with access to location-based services will rise by just under 30% between 2001 and 2007, to nearly 400 million. Over six years, this increase is not a huge one. This is because location-based services are already widely available across Europe - hence, the number of mobile phone users who have access to them will not grow exponentially.

Of the top fourteen markets in Western Europe surveyed, the ones earmarked for generating the most location-based traffic are: Germany, the UK, France, Italy and Spain. It is not surprising that between them they are tipped to generate nearly 85 percent of the total revenues, since these countries represent the most densely populated ones in Europe. It does not necessarily provide an accurate guide to the development and sophistication of location-based services either. Switzerland, for example, makes an interesting case study because all three operators have been offering location-based services for some time, the first ones being introduced as far back as December 1999.

The number of location-based service requests may provide a more useful guide. It has been forecast that the number of such requests will increase by more than fifty times in the period between 2001 and 2007. It is believed that location-based services involving information browsing may account for almost half of all location-based traffic. Such projections may be difficult to substantiate and depend on what is subjectively included in such a category. The rise in popularity of content-independent services such as "friend finder" ones may also put a large dent in such projections. It is notoriously difficult to predict what the "killer" location-based applications will be.

The revenues from location-based services for mobile operators in Western Europe have been compared with the revenues generated by voice traffic. In 2002, revenue from location-based services may account for 1.3% of those derived from voice traffic. By 2007, it may account for about 10%. In practice, it may be extremely difficult to determine revenues from location-based services. A service may only contain a location-based element and the revenue may not be solely derived from it.

A-GPS Sales

Forecasts for the sales of Assisted-GPS (A-GPS) handsets in Western Europe over the next five years can provide a useful perspective on the adoption of positioning technologies. Sales are not expected to begin until 2004, when total annual sales may be in the region of 3.4 million A-GPS handsets. This could almost double by 2007, with 6.3 million handsets sold annually. It has been predicted that the country with the greatest share of those handset sales will be Italy followed by the UK, Spain, Germany and France.

It should be noted that total annual sales for A-GPS handsets will still represent a relatively slight proportion of all mobile handset sales. This seems to reinforce the notion that A-GPS technology is for the high-end of the market. However, this may not necessarily be the case if operators decide to opt for handset-based solutions. Elsewhere in this study, it has been suggested that mobile operators may leap from cell-based methods to GPS, foregoing an intermediate phase utilising E-OTD techniques. If this is the case, A-GPS handset sales could be much higher.

Conclusions

European mobile operators believe that the European market is geared towards applications. Developing services with location as a key feature will enable the generation of new streams of revenues. In Europe, there is less emphasis on security and emergency services than in the US. However, there are signs that this may change.

Location-based services can be categorised according to the following 9 types:

1. Local information
2. Navigation
3. Mobile communities
4. Gaming
5. Commerce
6. Security
7. Resource management
8. Emergency services
9. Local billing

The Strategis Group forecasts (Oct 2001) that the number of mobile phone users with access to location-based services will rise by just under 30% between 2001 and 2007, to nearly 400 million. The markets in Western Europe expected to generate the most location-based traffic are: Germany, the UK, France, Italy and Spain. However, this does not reveal how advanced certain markets are. In Switzerland, for example, all three operators offer location-based services and the first ones were introduced as far back as December 1999.

It is believed that location-based services involving information browsing may account for almost half of all location-based traffic in 2007. This fails to take into account the increase in popularity of services that fall into the mobile communities category. "Friend finder" applications may become the next killer application. Revenue from location-based services may account for about 10% of the revenue derived from voice traffic in 2007.

Sales of Assisted-GPS handsets are not expected to begin until 2004, when total annual sales may be in the region of 3.4 million A-GPS handsets. This might double by 2007, with 6.3 million handsets sold annually. Sales might be much higher if mobile operators leap from cell-based methods to GPS.

Mobile Operators in Europe

This section is divided into three sections. Firstly, the background to the mobile communications market in each region is discussed. Secondly, a closer look at the location-based offerings of each mobile operator is taken. Thirdly, some conclusions about the general level of development in location-based services are drawn.

Regional Market Overviews

In this pre-study, Europe has been divided into regions for consideration: the Nordic markets, the Benelux markets, the Central European markets, the Southern European and the Eastern European markets.

The Nordic Markets

In this pre-study, this includes Finland, Denmark, Norway and Sweden.

Finland

Finland became the first country in the world to issue third-generation mobile licenses (Mar 1999). By mid-1999 the Ministry of Transport and Communications stated that 78.5% of Finnish households owned a mobile phone. Sonera has over two million mobile subscribers. The major rival for its mobile subscribers is Radiolinja, two-thirds of which is owned by the Helsinki Telephone Corporation. The country's third major GSM player is Telia, the Finnish arm of the Swedish PTO Telia. Telia's services are limited to Finland's three largest cities.

From Sonera's perspective, the outlook for new location-based services is somewhat gloomy. Sonera, once seen at the forefront of mobile technologies, has forecast that a mass market for 3G mobile services will not appear until 2004 or 2005. Sonera has been seen as a test case of whether new services and technologies can spur fresh growth. Despite a promising start, Sonera Positioning Services has withdrawn its positioning platform from the market and says it is "reorganising" its activities.

Radiolinja is marching forward with its own location-based services. Its "a friend finder" application is not operational anymore but it is entering a new area in April 2002 – fleet management and tracking. Telia is not currently offering location-based services in Finland though they are an important component of its offering in Sweden. DNA currently offers "Botfighters", a location-based game.

Denmark

There are 2.81 million mobile subscribers in Denmark, and the penetration rate is 54% - comparatively low for the region (Mar 2000). The main players are:

- Tele Danmark - the first to launch mobile services under Tele Danmark Mobil
- Sonofon - 53% owned by Telenor
- Mobilix (Orange) - owned by France Telecom Mobiles International
- Telia Danmark - owned by Telia.

Sonofon expects mobile data to be a major source of revenue in the future and so invests in the development of news, traffic, banking and weather WAP services; some of these services are naturally dependent on a location element and lay down a path to fully-fledged location-based services.

The mobile operators in Denmark are also set to bring out new location-based services - Mobilix has recently released a location-based game under its Orange portal.

Norway

The Norwegian mobile market is dominated by two operators: Telenor Mobil and NetCom ASA. There are 2.74 million mobile subscribers in Norway, just under two million of which are Telenor Mobil's (Q1 2000). Telenor has made good progress in location-based services and has released its "Info Here&Now" facilitating access to nearby services.

Sweden

With around 57.5% mobile penetration, Sweden trails only Finland and Norway (Q1 2000). Telia Mobile, a wholly owned subsidiary of Telia, is the dominant player with over two and a half million subscribers at the beginning of 2000. The second largest operator is Tele2 AB, whose Comviq and Tele2Mobil services are aimed at the residential and business markets respectively. The third GSM operator is Europolitan with a relatively small market share of around 16.5% (Q1 2000).

Telia has made considerable progress in launching a range of location-based services supplied by mobilePosition which is now owned by SignalSoft.

The Benelux Markets

In this pre-study, this includes Belgium and the Netherlands.

Belgium

There are 3.19 million mobile subscribers in Belgium (Q1 2000). Belgacom introduced its GSM service, Proximus, in 1994 and now has 2.3 million subscribers (Mar 2000). Proximus has launched a range of interactive data services through a new subsidiary, the Mobile Data Group. This includes stock exchange prices, weather reports, sports news and travel information via WAP (Apr 2000) Travel information is a good example of a service that lends itself well to the adoption of positioning technology.

The Netherlands

KPN mobile was the first mobile operator in the Netherlands, but saw its market share drop dramatically later on. It is owned by KPN Telecom (85%) and NTT DoCoMo (15%). The influence of NTT DoCoMo is likely to show itself in the release of sophisticated multi-media services with a strong location-based component. The second largest mobile operator is Libertel. Libertel is backed by Vodaphone and has just over a million customers (Mar 2000).

The market in the Netherlands is made more complex by the addition of three other players:

- Telfort - a wholly owned BT subsidiary
- Dutchtone - a joint venture between France Telecom and local financial groups
- Ben - 70.6% owned by Belgacom

There are five networks vying for mobile subscribers in the Netherlands, a country with a population of only 16 million people. In the intense competition, location-based services provide a useful means of revenue generation and product differentiation.

Central European Markets

In this pre-study, this includes Germany, Austria, Switzerland and France.

Germany

Germany's mobile market is the biggest in Europe in terms of mobile subscribers. Germany's mobile market is an interesting one - the rate of mobile penetration is only 29% (Q1 2000). According to the UN, per capita GDP is around 20% higher than in the UK where the penetration rate stands at 50%. The main mobile operators are:

- D2 Vodafone
- Deutsche Telekom's T-Mobil
- E-Plus
- Viag Interkom's E2
- Cellway

By the end of 1998, Vodafone had overtaken Deutsche Telekom's subsidiary T-Mobil to become the largest mobile operator in Germany. A joint venture between T-Mobil and its media subsidiary T-online called T-Motion was set up to concentrate on pan-European services. This includes WAP, GPRS and future UMTS services and the development of location-based services. Viag Interkom's E2 was introduced towards the end of 1998 and was marketed aggressively. This diminished the customer bases of its rivals.

Austria

There are 4.65 million mobile subscribers in Austria (Mar 2000), served by four mobile operators:

- Mobilkom - 75% owned by Telekom Austria
- max.mobil - 100% owned by Deutsche Telekom's T-Mobil
- Connect Austria
- tele.ring.

The penetration rate is 57.6%. The market leader Mobilkom is one of the first European operators to have introduced location-based services for its customers. The first alternative to Mobilkom was max.mobil. Connect Austria under the brand name ONE has 690,000 subscribers (Mar 2000). tele.ring, the fourth operator has launched its service via WAP (May 2000).

Switzerland

Switzerland's mobile market was liberalised comparatively late by European standards. Until April 1998, the only operator was the state-owned carrier Swisscom. Two new operators, Orange and Sunrise, entered the market in 1999 and broke a twelve-year monopoly. The new operators have struggled to compete with Swisscom's 91% share of the market. The newcomers have had to compete right from the beginning with Swisscom's location-based services. This provides an incentive for the development of their own location-based services.

The market in Switzerland has been described as the most advanced in Europe for such services. The first ones were introduced in December 1999.

France

The most popular network is operated by France Telecom Mobiles which claims nearly 50% of the mobile market (Q12000) with its digital network and Orange's portal. The closest competitor is SFR (owned by Cegetel and Vodafone) which provides a multi-access portal known as Vivazzi. This is a pan-European joint venture, held equally by Vodafone, and Vivendi Universal, a leading media and content company. Bouygues Telecom is the smallest mobile player.

Southern European Markets

In this pre-study, this includes Spain, Portugal and Italy.

Spain

Until January 1999, Telefonica and Airtel enjoyed a duopoly. In January 1999, a third GSM operator, Retevision Movil entered the market under the brand name Amena. One in four Spaniards have mobile phones (Q3 1999) This is a low figure by Western European standards: one reflecting a lower standard of living and lower GDP per capita. It is not clear in such circumstances where low incomes prevail whether or not location-based services can generate much revenue.

Portugal

The Portuguese mobile market is estimated to have reached a penetration of around 65% (Q1 2001). Markttest, an independent market research company, estimates that TMN (Portugal Telecom 100%) has a market share of 50% measured in subscriber numbers (Q1 2001). Two other mobile operators, Telecel (Vodafone Airtouch 50.9%) and Optimus provide the competition. Telecel is the closest competitor of TMN.

Italy

Though the mobile phone penetration rate in Italy is only about 50% (Q1 2000), the market has shown signs of saturation. The largest mobile operator is Telecom Italia Mobile (TIM), a 60% subsidiary of the national PTO Telecom Italia. There are three other mobile operators:

- Omnitel Vodafone
- Wind
- Blutel

Eastern European Markets

In this pre-study this includes Poland, Hungary and the Czech Republic.

Poland

Poland's mobile market was initially slow to get off the ground until the launch of two GSM networks in 1996: PTC's (Polska Telefonía Cyfrowa) and Polkomtel's. Centertel's GSM network followed in 1997. The market had expanded to reach 4.66 million mobile subscribers (Mar 2000). However, Poland suffers from low mobile penetration in comparison with other countries in Eastern Europe. Mobile penetration in Poland is only 26 percent (Q1 2002), whereas it is nearly 50 percent in Hungary, and approaching 70 percent in the Czech Republic.

Hungary

With mobile penetration at almost 50% (Q1 2002), Hungary enjoys a much better rate than in Poland. A third digital GSM network was added in November 1999. Westel is the biggest mobile operator, followed by Pannon GSM and Vodafone Hungary.

The Czech Republic

For an Eastern European country, the Czech Republic enjoys an extremely high mobile penetration rate of 70% (Q1 2002). Three mobile operators compete for subscribers: EuroTel Praha, Radiomobil and Cesky Mobile which is the newest operator.

The UK and Ireland

In this pre-study, this includes the UK and Ireland.

The UK

A flurry of activity began in the mobile communications market in the UK when the largest cellular operator, Vodaphone, merged with the US mobile telco AirTouch. This created Vodaphone AirTouch (Jan 1999). BT has since acquired the outstanding 40% of BT Cellnet from Securicor. This leaves it free to pursue an integrated service and marketing strategy.

Deutsche Telecom owns One 2 One, acquired in an £8.4 billion transaction. This represents an effort to secure a new source of revenue outside an increasingly competitive Germany. Orange and One 2 One have substantially eroded the market shares of Vodaphone and BT Cellnet in the last couple of years. One 2 One has a joint venture with the Virgin Group to allow the latter to sell Virgin-branded mobile phones.

Orange has a market share of 17.6%, whilst One 2 One has a share of 15.8%. (Q3 1999). At the same time, Vodaphone has a 36.7% share of the market, and BT Cellnet is not far behind with 29.9%. One barrier to competition in the UK is that due to lack of frequency there can only be four network operators.

The UK is highlighted by the Strategis Group as a market likely to generate a large amount of location-based traffic.

Ireland

Ireland's mobile market has been home to just two operators until recently (Q1 2000): Eircell, a subsidiary of eircom, and Esat Digifone. Since June 1996, Eircell's parent company eircom has been owned by KPN of the Netherlands. There are 1.2 million mobile subscribers in Ireland (Q3 1999).

The third operator, Meteor, which is owned by a consortium of Western Wireless and the Walter Group, together with Dublin's RF Communications originally planned a dual-band launch for 1999. This was delayed due to legal wrangles but eventually went ahead as planned.

The Market Situation: Mobile Operators and Their Location-Based Services

This section considers European operators and their location-based services, and agreements signed with other location-based companies.

Table of Mobile Operators and Their Location-Based Services

This table lists alphabetically the mobile operators, their location-based services, and partners in the location-based field. Where possible, the names of location-based services are listed under "service examples". The term "nearest "x"" refers to a set of services enabling the user to locate such things as shops, points of interest, emergency services, hotels, cash machines and restaurants.

Where mobile operators are present in a number of different countries, the services on offer in each market are listed - these are often different. Where the term "planned" is used for location-based services, the introduction of new services is highly probable, given that agreements have been signed with other location-based companies.

Mobile Operators in Europe and Their Location-Based Services

Mobile Operator	LBS Categories	Service Examples	Partners
Airtel	Local information Navigation	Nearest "x" Traffic info Route planner	Webraska
Ben		Planned	T-Mobile (Deutsche Telekom)
Bouygues Telecom		Planned	
BT Cellnet	Local information Navigation	FINDme Traffic info Nearest McDonalds	Ents 24 Kizoom Wcities
Cellway		Planned	
Deutsche Telekom	Local information Navigation Mobile communities	<i>Germany:</i> Nearest Taxi Nearest Hotel Online Wetter Restaurant Finder <i>Austria:</i> Nearest "x" Max.friendfinder <i>UK:</i> Nearest "x" Traffic info	Infospace In-fusio Kizoom Ngame T-Motion (Deutsche Telekom) uB-mobile
Digifone		Planned	Redknee
DNA	Gaming	Botfighters game	It's Alive
Eircell		Planned	Ericsson Mobilaris
E-Plus	Local information Resource management	nearest "x"	Webraska (Airflash) Cellpoint
EuroTel Praha	Resource management	Resource Manager	Cellpoint
France Telecom	Resource management	Resource Manager	Cellpoint
KPN		Planned	NTT DoCoMo uB-mobile VoltDelta Europe
Meteor		Planned	
Mobilkom	Local information	MobilGuide	Tele Atlas
ONE		Planned	Nokia
Orange	Local information Navigation Gaming Emergency services	<i>UK:</i> Orange Directory Cash Machine Finder Hotel Finder Emergency Services Driving Directions <i>Denmark:</i> Zonemaster game <i>Belgium:</i> Planned <i>Netherlands:</i> Planned <i>France:</i> Planned <i>Switzerland:</i> Route Planner Traffic news Cinema guide	Atchik CT Motion Ericsson Kizoom Ngame SignalSoft uB-mobile Webraska
Pannon	Local information	Navigator	
Polkomtel		Planned	CT Motion

Proximus		Planned	
PTC-Era		Planned	Siemens SignalSoft
Radiolinja	Navigation Resource Management	Tracking application	Arbonaut Nokia MS Location
Radiomobil	Navigation Resource Management	Paegas Navigator Paegas SMS locator	T-Mobile (Deutsche Telekom)
SFR		Planned	SignalSoft
Sonera	Local information	Missä? (Where am I?)	
Sonofon		Planned	Telenor uB-mobile
Sunrise	Local information Navigation	Ski info Events guide Directory assistance Transport info	
Swisscom	Local information Navigation Mobile Communities	Event Guide Weather Friend Zone	Vallis
Tele Danmark		Planned	
Telecel		Planned	Vivazzi
Telecom Italia	Local information Navigation	Nearest "x" Routing	Webraska
Telefónica Móviles		Planned	Nokia Ngame TCS (Xypoint) uB-mobile
Telenor	Local information	<i>Norway:</i> Info Here & Now: Nearest "x" Where am I? Events Weather Tourist info	Ericsson Mobilaris
Tele.ring		Nearest "x"	
Tele2	Resource Management	Resource Manager	Cellpoint
Telia	Local information Mobile communities Gaming	FriendPosition WeatherPosition HousePosition YachtPosition BikePosition Botfighters	Ericsson It's Alive Mobilaris mobilePosition SignalSoft
TMN	Local information	Nearest "x"	
Viag Interkom		Planned	Webraska
Vodafone	Local information Navigation Mobile Communities	<i>UK:</i> Find & Seek Nearest "x" Routing <i>Ireland:</i> Find Nearby Service Restaurant Guide <i>Germany:</i> Nearest "x" D2- NightGuide Edeka Tourisline Total D2-ShopFinder "Friend finder" planned <i>Netherlands:</i> Planned for Libertel	CustomWeather Ents 24 In-Fusio Map Info Ngame TCS (Xypoint) SignalSoft Vivazzi

		<i>Italy:</i> <i>Planned for Omnitel</i> <i>Vodafone</i> <i>Ireland:</i> <i>Nearest "x"</i> <i>Restaurant Guide</i>	
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Airtel (Spain)

Until January 1999, and Airtel and Telefonica enjoyed a duopoly. One in four Spaniards have mobile phones (Q3 1999) but it is not clear whether they are prepared to spend part of their low incomes on location-based services.

Nevertheless, Airtel is a customer of Webraska. Through the Vivazzi portal on offer in Spain, has the capability to provide the full-range of location-based services.

Ben (the Netherlands)

Ben is 70.6% owned by Belgacom and is one of the smaller players. Ben has more than a million customers in the Netherlands, holds a UMTS license, and is working with T-Mobile International of Deutsche Telekom which has location technology at its disposal. Location-based applications are certainly planned for next generation services.

Bouygues Telecom (France)

Bouygues Telecom is the smallest mobile player in France. Bouygues Telecom has shown an interest in the development of location-based services in the past, but it is unlikely to be able to compete with stronger brands like Orange. Orange already offers a comprehensive range of location-based services.

BT Cellnet (UK)

BT Cellnet has a market share of 29.9% (Q3 1999). Vodafone enjoys a larger 36.7% share of the market. BT Cellnet is competing fiercely with Vodafone in the location-based services area.

BT Cellnet's FINDme is a genuine range of location-based services able to recognise the user's location and find the nearest hotels, B&Bs, restaurants, car parks or local events and tourist information. It also includes local information on traffic, cash points, taxi firms, pubs, clubs, cinemas and football grounds. All this local information is collected in one place under a special "welcome" menu, demonstrating that these services are taken seriously by the operator. In addition, a promotional tie-in for McDonalds allows users to locate the nearest McDonalds by keying in a special number.

Cellway (Germany)

The rate of mobile penetration is only 29% in Germany (Q1 2000). Cellway's competitors are D2 Vodafone, Deutsche Telekom's T-Mobil, E-Plus, and Viag Interkom's E2. With lots of market share to play for, Cellway has announced its intention to develop its own location-based services.

Deutsche Telekom (Germany, Austria, UK)

Deutsche Telekom has developed the T-Motion portal which supports location-based services - the first of its WAP services provide information under "Taxi", "Hotel" and "Online Wetter" ("Online Weather") categories. This is complemented by "Clever Tanken" for the price of petrol at nearby petrol stations. A "Restaurant Finder" service helps locate restaurants, cafes, bars and beer gardens (Aug 2001). These services use positioning technology and do not simply require the manual inputting of location data.

Deutsche Telekom's T-Motion also provides max.mobil's "max.friendfinder" service in Austria (Aug 2001). This complements services to find the nearest bank or chemist, and other shops and services.

One 2 One in the UK, which was bought by Deutsche Telekom in 1999, has a range of pseudo location-based services which allow the user to retrieve traffic updates, search for a local store, garage or restaurant by entering a postcode or location name.

Digifone (Ireland)

Ireland's mobile market has been home to just two operators until recently (Q1 2000): Eircell and Esat Digifone. Digifone clearly wants to lay claim to a new source of revenue to maintain its market share through differentiating its product offering.

Digifone has signed an agreement with Redknee of Canada for Redknee's Location Services application (Dec 2001). Eircell is therefore unlikely to dominate the Irish market for long in terms of location-based services on offer.

DNA (Finland)

DNA is the newest and smallest operator in Finland. Sonera has over two million mobile subscribers and its major rival Radiolinja also has a large share of the market. The mobile penetration rate stands at over 80% in Finland. In a tough market, DNA is anxious to increase its market share dramatically.

It is important to note that DNA, with a much smaller share of subscribers, has launched "Botfighters", a stylised mobile game where robots seek out and kill other robots using location information. This is delivered by It's Alive of Sweden which specialises in games.

E-Plus (Germany)

The rate of mobile penetration is only 29% in Germany (Q1 2000). E-Plus's competitors are D2 Vodafone, Deutsche Telekom's T-Mobil, Cellway, and Viag Interkom's E2.

E-Plus provides AirFlash's location-based services to 6 million German mobile subscribers (Q1 2001). AirFlash recently merged with Webraska. There is therefore likely to be an upgrade to the services on offer. In addition, E-Plus has CellPoint's Mobile Location Broker as its location middleware platform (Nov 2001).

EuroTel Praha (Czech Republic)

EuroTel Praha operates in the Czech Republic which enjoys an extremely high mobile penetration rate of 70% (Q1 2002). It competes for subscribers with Radiomobil and Cesky Mobile, which is the newest operator.

EuroTel Praha has announced the implementation of CellPoint's Mobile Location Services platform and applications (Oct 2000). Resource Manager is the first application to be offered. In view of the high penetration rate, EuroTel is likely to build on its experience with Cellpoint and move towards a comprehensive range of location-based services.

France Telecom (France)

The most popular network in France is operated by France Telecom Mobiles. It claims nearly 50% of the mobile market (Q12000) with its digital network and Orange's portal. SFR is the closest competitor and provides services via the multi-access portal known as Vivazzi.

In the business sector, CellPoint has signed an agreement with France Telecom Mobiles (Jul 2000). The Fleet Management service supplied to France Telecom Mobiles is based on the Resource Manager Service from CellPoint.

KPN (the Netherlands)

KPN mobile was the first mobile operator in the Netherlands, but saw its market share drop dramatically later on. It is owned by KPN Telecom (85%) and NTT DoCoMo (15%). It has to compete with Libertel backed by Vodafone and three additional players in a complex market: Telfort, Dutchtone, and Ben.

This leads to the conclusion that KPN mobile will present a formidable range of location-based services in the near future. The integration of NTT DoCoMo's technology will be critical.

max.mobil (Austria)

The Austrian market is served by four mobile operators: max.mobil, Mobilkom, Connect Austria (ONE) and tele.ring. The penetration rate is 57.6%.

Max.mobil offers the standard range of nearby services and local information. It has also been bold enough to introduce max.friendfinder for the positioning of one's peers.

Meteor (Ireland)

Meteor will be keen to attack the market shares of Eircell and Esat Digifone - the only two operators until recently (Q1 2000). Meteor, the newest operator in Ireland, is not currently marketing location-based services. Meteor's market entry will make the incumbent mobile operators keen to differentiate themselves with such services in Ireland.

Mobilkom (Austria)

The market leader Mobilkom is one of the first European operators to have introduced location-based services for its customers. The Austrian market is served by three other mobile operators: max.mobil, Connect Austria (ONE) and tele.ring. The penetration rate is 57.6%.

Mobilkom offers MobilGuide over the WAP interface (Sep 2000). The addresses of banks and post offices, restaurants, shops as well as sports and fitness facilities are accessible to the user. The system uses Automatic Localisation based on Cell-ID or Manual Location Entry.

ONE (Austria)

ONE wants to roll-out location-based services as soon as possible. Location-based services have existed in Austria since September 2000. There are four mobile operators in total: Mobilkom, max.mobil, Connect Austria (ONE) and tele.ring.

Nokia has signed a contract with Connect ONE to supply its mobile positioning solution, Nokia mPosition, enabling the next generation location-based services for its mobile subscribers (Mar 2002). ONE has also announced the introduction of two new location-based services via SMS (Dec 2001). The first service enables the user to retrieve information on the price of petrol at nearby gas stations, and the second provides local traffic information. The content-partner for the traffic information is the motorist association ÖAMTC.

Orange (UK, Denmark, Belgium, the Netherlands, France, Switzerland)

Orange's initial range of WAP location-based services has been on offer for a year in the UK and features:

- Orange Directory - nearest pub, restaurant, cinema etc
- Cash Machine Finder
- Hotel Finder
- Emergency Services
- Driving Directions

Orange UK is upgrading its existing range of location-based services with Webraska (Dec 2001). The upgraded service offered by Orange uses network positioning to automatically locate the user, rather than relying on the manual typing in of an address. Webraska's Location Refinement system enables the service to match pre-defined locations such as home, office, train stations to particular cellular base stations. This provides the most relevant destination relative to the user's geographic position.

Orange is also in the news with Unwiredfactory (Oct 2001) for the release of a location-based game called "Zonemaster" in Denmark. This a "battle for land" game which takes place in real-life zones - the aim is to conquer as many areas as possible. Players have to be Orange customers.

The fastest growing mobile operator on the Belgian market, KPN Orange has attracted approximately 1.0 million subscribers since the start of its commercial operations in March 1999. Orange has access to location technology through its deal with Webraska and KPN Orange's existing services will benefit from the technology upgrade. Dutchtone, a wholly-owned subsidiary of Orange, will be able to tap into Orange's expertise in this area in the Netherlands.

France Telecom, the former monopoly, is launching a mobile portal through Orange with individualised life service channels: Orange Sport, Orange News, Orange Finance, Orange Travel, Orange Entertainment and Orange location-based services (Jul 2001). A fully functional range of location-based services is expected to be announced soon.

Orange offers Local guide, Route Planner, Traffic news and Cinema guide in Switzerland.

Pannon (Hungary)

Pannon is the second biggest operator in Hungary, after Westel. With mobile penetration at almost 50% (Q1 2002), Hungary enjoys a much better rate than in Poland.

Pannon which now has over two million subscribers in Hungary, offers Navigator via WAP (Jun 2001). It is initially restricted to Budapest and its surroundings, but Pannon GSM plans to expand the service. It is marketed as a digital tourist guide and gives directions to the nearest public service institutions, ATMs and places of entertainment. It works using cell-ID or manual data input.

Polkomtel (Poland)

Polkomtel launched a GSM network in Poland in 1996, at the same time as PTC-Era. It now competes with PTC-Era and Centertel, the third mobile operator. Mobile penetration in Poland is only 26 percent (Q1 2002), whereas it is nearly 50 percent in Hungary, and approaching 70 percent in the Czech Republic.

Polkomtel has been interested in location-based services since 2000. CT Motion has shipped its CelebriTY™ Services Platform to Poland, to be deployed in Monitel, a Polish ASP co-operating with Polkomtel (Jun 2000).

Proximus (Belgium)

Belgacom introduced its GSM service, Proximus, in 1994 and now has 2.3 million subscribers (Mar 2000). Two other operators compete for market share: Mobistar (France Telecom) and KPN Orange. There are 3.19 million mobile subscribers in Belgium (Q1 2000).

Proximus has forecast delays in the roll-out of its 3G services and this may slow up the development work in the location-based area, though its present services lend themselves well to the concept of positioning. Weather reports, and travel information via WAP could make good use of Cell-ID positioning methods.

PTC-Era (Poland)

PTC-Era, Poland's largest mobile network operator with more than 3.5 million GSM subscribers, competes with Polkomtel and Centertel. Penetration in Poland is still only 26 percent (Q1 2002). Nevertheless, location-based services are to become a feature of the mobile lifestyle in Poland.

PTC-Era is working with Siemens. PTC-Era has chosen Siemens IC Mobile in cooperation with SignalSoft to enable the delivery of location-based services via WAP and SMS (Nov 2001).

Radiolinja (Finland)

Radiolinja's closest competitor Sonera, and DNA, a smaller mobile player, both have location-based services to offer. One of the highest mobile penetration rates in the world (over 80%) is enjoyed in Finland. Radiolinja wants to exploit the opening left by Sonera's retreat with the introduction of new location-based services.

Radiolinja has experimented with services that have a location-based "feel" but do not use any positioning technology - two such services are its "Friend Finder" service, and its current routing service, where the point of departure and the destination are entered manually. Its Friend finder service is no longer offered. It did not really support positioning since details of the user's location had to be entered manually. In view of the ongoing development work with Nokia, these pseudo location-based services are likely to be replaced by the genuine article in the near future.

Radiolinja, Nokia and MS Location are testing an MS Location tracking application in the Radiolinja network in Estonia (Mar 2001). There are plans to release a tracking application in the near future.

Radiomobil (Czech Republic)

Radiomobil competes with EuroTel Praha and Cesky Mobile in the Czech Republic. The Czech Republic enjoys an extremely high mobile penetration rate of 70% (Q1 2002). RadioMobil is partly owned by T-Mobile International.

Radiomobil has a new location-based offering for its customers in the Czech Republic, in the form of two new services (Oct 2001). The first of them, Paegas Navigator, allows Paegas customers to search automatically for various types of objects located in their proximity. Paegas SMS Locator enables authorised people to track persons and vehicles equipped with mobile phones with a Paegas Profi SIM card. It works on any mobile phone. Paegas SMS Locator is designed not only for corporate clients, but also for the general public. This builds on a previous SMS locator service for the corporate sector.

SFR (France)

SFR is the closest competitor of France Telecom and provides services via the multi-access portal known as Vivazzi. France Telecom Mobiles claims nearly 50% of the mobile market (Q1 2000) with its digital network and Orange's portal. It is not surprising that SFR is hoping to differentiate itself with location-based services.

SFR is integrating SignalSoft's products into its network, bringing location-based information to its mobile subscribers in the near future (Dec 2001).

Sonera (Finland)

Sonera is now competing with two other operators using location-based technology in Finland. Both Radiolinja and DNA are competing with Sonera in the location-based services area. In a market with such a high rate of mobile penetration (over 80%) it may be the only means of differentiation.

The range of services on offer initially from "Sonera Pointer" included "Pointer Guide" to help locate local accommodation, events, guides and maps, and "Pointer Petrol" to help find the cheapest and nearest petrol; these services have now been taken off the market.

An interesting service still on offer is "Missä" (Where am I?) which gives the coordinates of the user's location by SMS. Sonera Positioning Services' retreat from the market has been noted. However, in view of the increased competition a re-launch might be imminent.

Sonofon (Denmark)

Sonofon is competing against three other players in Denmark: Tele Danmark, Mobilix (Orange) and Telia Danmark. There are 2.81 million mobile subscribers in Denmark, and the penetration rate is 54% - comparatively low for the region (Mar 2000).

Sonofon, Denmark's second largest telecommunications company, is 53.5% owned by Telenor. In view of Telenor's present range of location-based services, it is likely that similar services are being developed for Sonofon too.

Sunrise (Switzerland)

Sunrise entered the mobile market at the same time as Orange in 1999. This put an end to Swisscom's twelve-year monopoly. The newcomers have had to compete right from the beginning with Swisscom's location-based services. The market in Switzerland has been described as the most advanced in Europe for such services.

Sunrise Mobile provides Ski Info, Events guide, Directory assistance, and Transport info in Switzerland.

Swisscom (Switzerland)

Swisscom introduced the first location-based services in Switzerland (Dec 1999). Sunrise and Orange both offer their own location-based services in a highly advanced market for location-based services.

Swisscom Mobile offered Friend Zone, Event Guide and Weather. Within 24 hours of the release of Swisscom's location-based services a thousand people has signed up without any marketing. It is worth noting that for Swisscom, 60 percent of the LBS traffic was by SMS. The revenue generated was claimed to be 3 Euros per subscriber per week, an encouraging proportion for those in the telecom industry who would like to see these services generate an additional stream of revenue.

Tele Danmark (Denmark)

Tele Danmark is the largest operator in Denmark. It is competing against three other players: Sonofon, Mobilix (Orange) and Telia Danmark. There are 2.81 million mobile subscribers in Denmark, and the penetration rate is 54% - comparatively low for the region (Mar 2000).

Tele Danmark (TDC) is emphasising the importance of launching UMTS (of which location-based services are a critical component) quickly and smoothly.

Telecel (Portugal)

Telecel (Vodafone Airtouch 50.9%) and Optimus provide the competition for TMN (Portugal Telecom 100%) in Portugal. Telecel is the closest competitor of TMN which has a market share of 50% (Q1 2001). The Portuguese mobile market is estimated to have reached a penetration of around 65% (Q1 2001).

Telecel is offering the multi-access portal Vivazzi (Oct 2001), so the release of location-based services may not be far away in Portugal. Vodaphone already offers location-based services through its Vivazzi portal in other countries.

Telecom Italia (Italy)

The largest mobile operator in Italy is Telecom Italia Mobile (TIM), a 60% subsidiary of the national PTO Telecom Italia. There are three other mobile operators: Omnitel Vodaphone, Wind and Blutel. Though the penetration rate is 50% (Q1 2000) the market is showing signs of saturation. Telecom Italia is looking for new ways to generate revenue.

Telecom Italia is working with Webraska for the provision of location-based services to Telecom Italia's 21.6 million customers (Q1 2001). The service displays the best routes to hotels, restaurants, service stations, car parks, ATMs, hospitals, railway stations and airports.

Telefónica Móviles (Spain)

Telefónica enjoyed a duopoly with Airtel until January 1999. One in four Spaniards have mobile phones (Q3 1999). This is a low figure by Western European standards: one reflecting a lower standard of living and lower GDP per capita. Nevertheless, Telefónica believes location-based services can generate new revenue in Spain.

Telefónica Móviles is cooperating with Nokia on the development of applications for value-added services for Telefónica's clients (Jul 2001). This applies to both the business and consumer segments. In the initial phase, the commercial services will be based on technologies currently available in the Telefónica Móviles network. This includes SMS, WAP and location-based services. The ongoing development of location-based services is expected to continue into a second stage which focuses on third-generation UMTS technology.

Telenor (Norway)

Telenor Mobil and NetCom ASA dominate the Norwegian mobile market between them. There are 2.74 million mobile subscribers in Norway, just under two million of which are Telenor Mobil's (Q1 2000).

Telenor Mobil and Pocket-IT, a location-based services enabler, are cooperating in the launch of the first location-based service in Norway (Apr 2001). A range of services named "Info Here&Now", including "Where am I?", events, weather, tourist attractions and nearby services is available. To access the location based services, the user is charged 10 kroner (1.2 Euros) when he or she was positioned. It was free of charge during the promotion period. "Where am I?" allows the user to retrieve information on his or her location. Area maps area with the three nearest ATMs, coffee bars and pharmacies are also included.

Tele.ring (Austria)

Tele.ring competes with three other mobile operators in Austria: Mobilkom, max.mobil, and Connect Austria (ONE). Location-based services have existed in Austria since September 2000.

Tele.ring has hosted location-based services in Austria since March 2001, for the standard set of nearby shops and services: chemists, ATMs, taxis and petrol stations.

Tele2 (Sweden)

Tele2 is the second largest operator in Sweden and competes directly with Telia, the dominant player. Telia Mobile has over two and a half million subscribers (Q1 2000). The third GSM operator is Europolitan with a relatively small market share of around 16.5% (Q1 2000).

Tele2 is likely to develop a range of location-based services. There is an agreement allowing Tele2 to use CellPoint's Mobile Location System (Q4 2000). CellPoint GSM positioning technology, applications and Internet services are available to Tele2 mobile phone users through "Tele2Mobil Position" based on the Resource Management Service (Nov 1999).

Telia and Tele2 are involved in a joint venture to create a UMTS network covering the whole of Sweden. Although the network building is shared, there is room for competition between Tele2 and Telia in the value-added services area. Location-based services are an integral part of this.

Telia (Sweden)

Telia, the incumbent mobile operator in Sweden, has over two and a half million subscribers (Q1 2000). Telia Mobile is making speedy progress in launching new location-based services onto the market.

The release of "friendPosition" marks the fifth location-based service delivered to Telia (Q4 2001) by mobilePosition, which is now owned by SignalSoft. The other applications provided by mobilePosition are: weatherPosition, housePosition, yachtPosition and bikePosition. In addition to these, It's Alive is currently supplying Telia with "Botfighters".

TMN (Portugal)

TMN is the incumbent mobile operator in Portugal with a market share of 50% (Q1 2001).Telecel (Vodafone Airtouch 50.9%) and Optimus provide the competition for TMN (Portugal Telecom 100%) in Portugal. Telecel is the closest competitor of TMN. The Portuguese mobile market is estimated to have reached a penetration of around 65% (Q1 2001).

TMN (Portugal Telecom 100%) offers its WAP location-based services to its mobile subscribers (Feb 2001).

Viag Interkom (Germany)

Viag Interkom's competitors are D2 Vodafone, Deutsche Telekom's T-Mobil, E-Plus, and Cellway. The rate of mobile penetration is only 29% in Germany (Q1 2000). Viag Interkom plans to offer its customers location-based services which rely on an application platform provided by Webraska who recently merged with Airflash.

Vodafone (UK, Ireland, Germany, the Netherlands)

Vodafone UK, through the portal Vizzavi and its Find & Seek, currently provides a service that finds essential local shops and services using a WAP mobile phone. It can identify the user's location and give details of nearby services supported by an on-screen map of how to get there.

In the Irish market, Eircell Vodafone, with a customer base of over 1.7 million, has been the most active in the location-based domain. Once again though, these services are not strictly location-based services. Currently on offer are: a Find Nearby Service for the Dublin area and a Restaurant Guide service, both of which rely on the manual inputting of location data and only available with a WAP phone.

D2 Vodafone in Germany has a comprehensive range of services currently on offer over WAP based on the "Where is the nearest x ?" concept. These include:

- D2-NightGuide - nearby cinemas, parties, taxi services, chemists and hotels
- Edeka - nearest supermarket
- Tourisline - hotel accommodation
- Total - nearest Total, Elf or Fina petrol station
- D2 ShopFinder
- "Friend Finder" - due to be launched in the near future

Libertel, backed by Vodafone, is expected to have location-based services in the pipeline for the Netherlands. Omnitel Vodafone has conducted experiments with location-based technology.

Conclusions

The sophistication and breadth of the mobile operators' location-based offering is evaluated here. Using the 9 service categories presented in "The European Market: Statistics and Analysis", it is possible to add up the number of service categories each operator covers. This serves as a guide to the sophistication of their offerings.

Table of Mobile Operators and Types of Services on Offer

	LOC	NAV	MOB	GAM	COM	SEC	RES	EME	BIL
Airtel	YES	YES							
BT Cellnet	YES	YES							
Deutsche Telekom	YES	YES	YES						
DNA				YES					
E-Plus	YES	YES	YES						
EuroTel							YES		
France Telecom							YES		
ONE	YES	YES							
Orange	YES	YES		YES				YES	
Max.mobil	YES		YES						
Mobikom	YES								
Pannon	YES								
Radiolinja		YES					YES		
Radiomobil		YES					YES		
Sonera	YES								
Sunrise	YES	YES							
Swisscom	YES	YES	YES						
Telecom Italia	YES	YES							
Telenor	YES								
Tele.ring	YES								
Tele2							YES		
Telia	YES		YES	YES					
TMN	YES								
Vodafone	YES	YES	YES						

Key to Table:

LOC = Local Information

NAV = Navigation

MOB = Mobile Communities

GAM = Gaming

COM = Commerce

SEC = Security

RES = Resource Management

EME = Emergency Services

BILL = Local Billing

Mobile operators which offer a single type of location-based service to consumers opt for Local information in the consumer sector. In the B2B sector, they opt for Resource management. There is one notable exception, DNA, which offers a location-based game. Operators which cover 2 categories prefer to opt for location-based services in the areas of Local information and Navigation.

Operators which cover 3 categories differ in their approach:

- Deutsche Telekom, E-Plus, Swisscom, and Vodafone offer location-based services in the Local information, Navigation, and Mobile Communities areas.
- Telia straddles Local information, Navigation, and Gaming. These operators enjoy a relatively high degree of sophistication.

Orange is the only operator to cover 4 categories. These are: Local information, Navigation, Gaming and Emergency services. The inclusion of Emergency services, a type of service expected more in the US, is an interesting development. In the future, the Europeans may adopt more such location-based services, along with ones falling into the Security category.

In the next few months, competition in location-based services is set to intensify. Three agreements have been signed in the last 6 months for the provision of location-based services. The operators involved are not currently offering such services. They are:

- Digifone (Ireland) partnering with Redknee of Canada (Dec 2001)
- PTC-Era (Poland) partnering with Siemens and SignalSoft (Nov 2001)
- SFR (France) partnering with SignalSoft (Dec 2001)

Operators which already have location-based services are implementing upgrades to stay competitive. Two good examples are:

- Connect ONE (Austria) partnering with Nokia (Mar 2002)
- Orange (UK) partnering with Webraska (Dec 2001)

Plenty of other operators are planning location-based services. By the end of 2002, about 40 mobile operators will be offering location-based services to their mobile subscribers. The competition will be intense and location-based services will be a feature of everyday mobile life. There will come a point when they are taken for granted by the public at large. Whether these services will generate the hoped for revenues is an open question. They may simply be seen as service-enablers rather than clear-cut money spinners.

Content and Service Providers

This section considers different kinds of content and services. Major content and service providers in the market are considered: their added-value propositions and recent activities with mobile operators in Europe.

Content: A Critical Factor in the Differentiation of Services

According to a December 2001 Frost and Sullivan report entitled, "US Mobile Location-Based Services Market", the need for mobile content and services is expected to grow at an unprecedented pace as more people access the internet through mobile handheld devices such as PDAs and smartphones. The study suggests that combining location-sensitive services with information tailored to users' individual interests offers lucrative opportunities for a range of possible market participants. Both mobile operators and retailers can capitalise on this.

Possible applications range from pure content and advertising, to navigational services and location-sensitive billing. In both US and European markets, differentiation of services will likely attract new users. To attract new users, carriers must differentiate value propositions by providing superior content and applications. Hence, content may play a critical role in the success of location-based services.

Content and service provision has been classified according to six categories:

- Mobile Communities
- City Guides
- Directories
- Games
- Travel
- Map Data

Content providers and their content propositions have been placed into one of these six categories.

Mobile Communities

Mobile communities rely on the notion of community-based channels for people with a mobile lifestyle. The specific target audience is invariably the youth segment of the mobile market.

Atchik

Based in France, Atchik was founded in August 1999, with a mission to provide mobile operators with ready-to-go value added services. The current product offering includes services under the following categories:

- Life management
- Fun and entertainment
- Messaging
- Dedicated information
- Service bundles
- Event animations

Support is provided for location-based services via: SMS, SIM TOOLKIT, WAP and GPRS.

Orange was the first customer, and by September 2000, another five GSM operators in Europe had signed up. Its services are currently available to 30 million subscribers. In October 2001, Orange France and Orange Switzerland released Atchik services.

Vallis

Based in Israel, VALIS is the creator of cellmaZe, which it calls a cellular teen channel. CellmaZe is backed by AOL-Time Warner capital investment. The cellmaZe channel includes:

- Instant Locator
- Instant Messenger
- Privacy management
- Chat
- Dating
- Games

This amounts to a branded package of interconnected community services for a specific target audience.

The cellmaZe system, is designed to be compatible with any existing digital mobile network. It is operational on the Mircs Motorola Network in Israel (Oct 2000), and is commercially available in Switzerland through Swisscom Mobile (May 2001). D2 Vodafone and Vizzavi are introducing the first location-based mobile community in Germany, to go live on Vizzavi in the fall of 2002 (Mar 2002).

Its partners include: Cambridge Positioning Systems (CPS), LocatioNet, Swisscom Mobile, SignalSoft, Vodaphone and Vivazzi.

MobilePosition

mobilePosition, founded in 1999, was acquired by US-based SignalSoft in May 2001. It develops applications and technical solutions for location-based services. The company provides its applications to operators and portals.

mobilePosition places an emphasis on community applications that bring real-time information to people on the move. In particular, friendFinder, bikePosition and yachtPosition aim at specific communities of people. friendPosition is available over Telia's network in Sweden (Nov 2001).

Its partners are Telia and SignalSoft.

Siemens

m.traction covers a range of solutions provided by Siemens mobile for implementing multimedia services for UMTS networks. Many of the services are location-based and aim at mobile communities.

m.traction Friends enables friends to locate each other via WAP phone or standard handset (via SMS). For operators and service providers this allows service differentiation with the aim of attracting young customers. Though this application is mainly intended for the younger generation, it could also be for parents and co-workers as well.

Many of the other tested applications are in the mobile communities domain too. For example, m.traction 3G Chat for Windows CE based PDAs, City on Air for festivals and special events, Games, and Mail for multimedia all have a community feel to them.

City Guides

City Guides refers to content about cities: tourist attractions, points of interest, and entertainment. This is quite distinct from the map data itself.

10Best

10Best specialises in edited city guide content. Its goal is to provide an unbiased city guide to the most amazing attractions, the most interesting museums, the finest restaurants, the most comfortable hotels and the hippest nightclubs. Mediocre entries are excluded.

There are 301 featured destinations worldwide, but the content is weighted in favour of the US:

- 133 destinations are in the States
- 28 in the UK
- 13 in France
- 13 in Germany

10Best also powers the applications. This enables wireless carriers to offer location-based services to their users, customised for any wireless device - PDAs (Palm Pilot, Visor, etc.), RIM Pagers and Web-enabled wireless phones.

10Best participates in SignalSoft's local info Alliance program (Mar 2000). Hence, SignalSoft showcases 10Best's offering to wireless network operators around the world.

Partners include SignalSoft, Nokia and Palm.

Ents24

Ents24 provides entertainment listings and information for the web, PDAs and wireless devices in the UK. Coverage extends to every city and town in the UK under categories such as: live music, clubs, cinema, comedy and theatre. Listings and information can be accessed with a WAP-enabled mobile phone or PDA.

Ents24 is partnering with branded portals in the UK. At the present time, these include: Genie from BT and Vizzavi from Vodafone.

uB-mobile

The company began in the field of GPS applications and SMS software before focusing on WAP content services in February 1998. One of its products is the uB-WAP City Guide for mobile portals. The guide has worldwide coverage of 46 destinations in five languages: English, Italian, German, Spanish and French.

Partnering with Deutsche Telekom's T-Online in Switzerland (Nov 2001), a whole package of uB services is on offer to subscribers. Some have a location-based component. The package includes: InfoSMS, WebSMS, SMS Groups and Ringtones & Logos.

Its technology partners are: BT Cellnet and SignalSoft. The distribution partners are: T-Online, Swisscom, Eurotel, Sonofon, One, Sonera Zed, Eurotel, Orange, KPN telecom, Telefonica. Hence, coverage of the European market is extensive with ten wireless operators distributing content.

wcities

Founded in 1998, wcities is a location-based information service provider with coverage that currently spans over 400 major world cities. There are operations in over 70 countries. It is a multi-platform information service provider for wireless operators, WAP portals, web portals and travel service providers. wcities has attracted a \$15 million investment from BT Openworld for a 17% equity stake in wcities. (Nov 2000).

On the technology front, wcities is partnering with Ericsson (Q1 2001). Collaboration extends to Ericsson's partner TomTom and its maps and route services. Though Ericsson has its own positioning technology, wcities claims it can integrate its location-based information service with positioning systems deployed by any mobile network.

Customer's include BT's genie and Orange.

whatsonwhen.com

whatsonwhen was founded in May 1999 in London. The company markets itself as a worldwide events guide which adds the critical element of "when". Its mission statement says the goal is: "To become the global market leader in the provision of events information to businesses and consumers across all platforms, whether it be web, WAP, PDA or digital TV". The best times to visit places of interest to see off-beat things such as natural phenomena (meteor showers, eclipses or flowers in bloom) are a feature of the presentation.

It is partnering with ebookers.com to offer discounted flights and the Online Travel Company for car hire, and PlaystoStay, a hotel booking engine. Non-disclosure agreements have been signed with some of its 3G mobile clients so no information has been divulged about work for them.

However, a branded WAP event service for Mviva and an event calendar for Orange's website are two current projects. Mviva is an independent mobile portal backed by AOL, with operations in the UK, the Netherlands, France, Sweden, and Spain. Another noteworthy partner is AirFlash which has now been incorporated into Webraska.

Citikey

Citikey was a promising pan-European wireless city guide that went bankrupt in November 2000. Citikey's case was not helped by the slow uptake of phones based on wireless application protocol (WAP) in Europe. The real reason, however, behind its decision to file for bankruptcy liquidation may be much more complex.

e-street acquired Citikey's technology in 2001 and is currently working on developing a new version of the PDA product.

Directories

Directories refers to listings for businesses, shops, and restaurants and lots of other services. Maps and directions may also be feature, but this is not the central element of the service. Directories for mobile use are often the subject of agreements between mobile operators and directory providers in individual countries.

InfoSpace

InfoSpace operates offices in the United States, Canada, Brazil, Australia, the United Kingdom and the Netherlands. Infospace provides an array of products some of which are location-based. In particular this includes: yellow pages, maps and directions.

The product offering also extends to:

- Address Book
- Calendar and To-do List
- E-mail
- Instant Messages
- Alerts

These services are delivered with the partner's logo and brand to strengthen the existing product.

InfoSpace is partnering with Virgin Mobile to offer a range of SMS and WAP-based wireless Internet services built on the InfoSpace platform (Oct 2001). Virgin Mobile provides the service under its existing brand of VirginXtras. Deutsche Telekom's VoiceStream is also partnering with InfoSpace.

VoltDelta Europe

Established in 1992, with locations in the UK and the Netherlands, Volt Delta employs over 70 people across Europe. Volt Delta's business focuses mainly on the telecommunications sector. Its customers are typically large call centre operators and include some of Europe's major telephone companies.

Its OASIS product supports the following:

- Mobile directory assistance
- Location-based services
- International directory assistance
- Operator services
- Talking yellow pages
- Web and WAP based services

CustomWeather, a supplier of syndicated weather data, is partnering with VoltDelta (Jan 2002). CustomWeather's forecasting and ski report services are to be offered to VoltDelta customers via Directory Assistance operators.

Its partners are: Cable and Wireless in the UK, KPN Telecom in the Netherlands, SEAT Pagine Gialle in Italy, and KPN-Orange in Belgium.

Multimap.com

Multimap.com of the UK provides services on the internet: over fixed connections and via WAP. The service includes:

- Store Finder
- Interactive internet maps
- Aerial photographs
- London Underground maps
- Weather forecasts

Multimap.com's main product, the Store Finder service, is available for use on both the web and WAP. Businesses with multiple outlets such as retailers can provide information on branch

locations and opening times throughout Great Britain. Other services include detailed travel directions using Driver Restricted Information (no left turn/right turn and one-way streets).

Business relationships exist with many of the UK's leading retailers, such as Woolworths, electrical retailer Comet and B&Q home improvement stores, in addition to the supermarkets chains Tesco and Sainsbury's.

Multimap.com has a flexible business outlook demonstrated by work with Sussex Police in England (Nov 2001). An "abandoned vehicle finder" service for Sussex Police is in operation to combat the growing problem of abandoned cars littering the countryside.

Virgin's branded portal is also a client, offering Multimap.com's services to its customers.

UKcompass

UKcompass offers "Find my nearest" and store locator services to chains of outlets. Clearly, these services are close to those offered by Multimap.com. Postcodes are entered manually with this service and there is little evidence of experimentation with positioning technology. Searches can be carried out with a WAP enabled mobile phone, or on the web. UKcompass offers the following search categories: Shops, Services, Nights Out, Food, Banking, Sport and Days Out.

Games

Games refers to the development of location-based games.

In-Fusio

Created in August 1998, In-Fusio one of the first to launch the concept of games for mobile phones. Today, it is one of the foremost suppliers of downloadable games as well as being a mobile games service provider.

In-Fusio and Webraska have partnered to create the first location-based games on mobile phones (1999). However, the current games in In-Fusio's offering do not have a location-based element. It's Alive (Sweden) is the nearest competitor and location-based technology is already on offer in its selection of games. In-Fusio needs to update its location-based offering to compete effectively.

In-Fusio distributes its games through 12 portal and operators worldwide including: D2 Vodafone, Orange France, Vizzavi Europe, Terra Mobile, T-Motion, Sunday, China Mobile, and Telstra.

It's Alive

It's Alive was founded in early 2000. The company is funded by the venture management company Speed Ventures and located in Stockholm, Sweden.

It's Alive offer the world's first location-based mobile game, BotFighters (Sep 2000). A second location-based game, Supafly, is currently on offer. Supafly is a location-based virtual soap opera where, "intrigues, gang conflicts, and romance are the tools of the trade for becoming a virtual celebrity." This is a new concept - a soap opera game encouraging interaction and promoting characterisation.

Many of It's Alive's partners are key players in the market: Ericsson, SignalSoft, Cellpoint Mobilaris, and LocatioNet. The customers who offer Botfighters are: Telia (Sweden) and DNA (Finland).

nGame

nGame was founded in August 1997, following some ten years' research by three Cambridge University graduates. The company's core aim is to provide innovative multi-player gaming experiences on a wide variety of new platforms. nGame content can be made available in English, French, German, Spanish, Portuguese, and Japanese.

It is yet to be seen whether nGame will bring a new dimension to mobile gaming with location-based games. Rick Owen, marketing manager at nGame, believes there are socially acceptable possibilities for location-based games:

"Location-based games address a market which to date wouldn't have been interested in computer gaming. They get you out of the house and into the fresh air, and they encourage sociability. There are ideas for dating games where you are matched with someone in your vicinity and directed to them: instant blind dates!"

Its partners and distributors reflect an expertise in the location-based field. Airflash is a major partner and the distributors are: T-Motion, Orange, Vodaphone, Telefonica, Vodaphone, and Mviva (an independent portal).

Travel

Travel refers to mobile commuting or traveling, and the tools that inform mobile users as they move from place to place. It relates to two specific areas: navigation and tourism. The relevant tools include: maps, routing, travel information, and even weather forecasts (for tourists and commuters).

Tom-Tom

Established in 1991, in the Netherlands, TomTom is a range of travel products and services for users of smartphones and handheld computers. TomTom provides travelers with local information, personal navigation tools, entertainment and assistance with foreign languages.

The products include:

- TomTom Route Planners
- TomTom CityMaps - for Great Britain and the rest of Europe
- TomTom Dictionaries
- The Michelin Red Guide

Its partners are: Michelin (for travel information), Nokia, Ericsson, Symbian, and Psion; the data suppliers are: Tele Atlas and Navtech (for street planners), and AND (for route planning).

MapQuest Europe

MapQuest supplies directions, maps, traffic, and local information via handheld devices like wireless web phones, PDAs, and pagers. In addition to pan-European coverage from MapQuest in the US, internet sites in UK, France and Germany provide a service focusing on these respective markets. Driving directions are available in 9 different languages - Danish, Dutch, English, French, German, Italian, Norwegian, Spanish and Swedish.

Partners worthy of note include: Tele Atlas, Navigation Technologies Corporation (Navtech), and AND data solutions.

MapInfo

The US-based MapInfo Corporation was founded in 1986 and became a public company in February 1994. MapInfo has more than 600 employees worldwide, and its global footprint includes subsidiaries in Canada, the United Kingdom, Germany, Australia and Japan; distribution relationships throughout Europe and Asia.

Its products are focused on mapping, routing, and geo-coding. Consumer mobile location services focus on the following types of services:

- Emergency services
- Roadside assistance
- Find the nearest services
- Driving directions and traffic updates
- Location-based telephone billing options and call plans

Vodafone Multimedia (of Vodafone UK) is partnering with MapInfo for its wireless location-based services (Nov 2001) The services are on offer through Vodafone's Vivazzi consumer portal. Vizzavi's Find & Seek, enables WAP customers in England, Scotland and Wales to locate and identify a broad range of information about restaurants, shops, banks and other retail services.

Maporama

Maporama was founded in February 2000 by three entrepreneurs. Maporama is a leading European provider of location-based applications consisting of high-quality mapping and routing turnkey products. It is addressing the world market, offering global mapping, itinerary and directory capabilities in multiple languages. In the consumer sector, global geocentric information is available from any Internet-enabled device such as PC, Palm Pilot, WAP or WEBtv.

In the business sector, portals and telecommunications companies can make use of the following services:

- Mapping and routing - driving directions, directions on foot, and public itineraries
- Points Of Interest and Proximity Search
- Real-time weather information - pan-European service
- Directory assistance - Yellow Pages, White Pages and searches

Its partners include many big names: CPS, SignalSoft, Cellpoint, Benefon, Ericsson, Nokia, Microsoft, IBM, Tele Atlas, Navtech, and Palm.

Genimap

Genimap, a unit of the SanomaWSOY Group, is a mapping company from Finland. It is now concentrating on developing location-based services for network operators and portals. In the consumer sector, Genimap provides applications for the internet and mobile internet.

Genimap supplies its Mobile Applications suite for operators, portals and other service providers (Feb 2002). This enables them to launch location-based services to consumer and corporate markets. The Mobile Applications suite consists of three key applications: AddressFinder, RouteFinder and NearestFinder. The Genimap Navigator is commercially available in April. The first versions of the product are tailored for the Nokia 9210 Communicator and Windows CE enabled mobile devices.

Its notable partner is Benefon. They are now co-operating in the mobile telematics market (since last year). Genimap also provides the downloadable maps for Benefon GSM+GPS navigation handsets.

Webraska

Webraska provides solutions to mobile operators, application developers and telematics service providers seeking ready-to-launch location-based applications and services. Webraska strengthened its market position via a merger with AirFlash, a provider of applications for network operators and wireless service providers (Sep 2001). The merger makes business sense. Webraska is able to bring its expertise in mapping and navigation, and Airflash its expertise in applications.

In the context of the category "travel" its products include:

- Yellow Pages
- POI Finder (Points of Interest)
- Maps
- Directions
- Community location-based services

Signalsoft is integrating Webraska's SmartZone GeoSpatial Platform (SGP) into its offering to become a reseller of Webraska's middleware (Jan 2002). SignalSoft will offer mobile operators an enabling platform for location-based services, attempting to span the whole value-chain. Webraska is providing a location-based upgrade for Orange UK (Q4 2001), and AirFlash and Cambridge Positioning Systems are teaming up (Sep 2001).

Lots of big players are partners. On the service provision side: Blu, Telecom Italia Mobile, Viag Interkom, and Vivazzi (Netherlands) have teamed up. There are technology partnerships with Cambridge Positioning Systems, Cellpoint, Ericsson, IBM, Nokia, Oracle, SignalSoft, Voxmobili and Xypoint. Map data is supplied by Tele Atlas, and Navigation technologies. Games expertise is tapped from In-Fusio.

Kizoom

Kizoom was formed at the end of 1999. It builds personalisation engines, user interfaces and back end platforms to travel information over the mobile internet via WAP, and SMS. Kizoom aims to build complex applications with its core competence in software engineering.

Orange UK provides a service with real-time information using Kizoom's engine (Dec 2001). Its partners are: Orange, BT's genie, T-Motion, and Vivazzi.

OAG

OAG operates globally from offices in the United Kingdom, United States, Hong Kong, Japan and Singapore and is supported by a network of representatives in many other countries. The OAG brand has evolved from the 1993 merger of the UK-based business travel information provider ABC with the Official Airline Guides in the US. OAG is best known for its flight guides.

Its notable partner is T-Motion (Deutsche Telekom).

CustomWeather

CustomWeather is a San Francisco-based provider of weather content. It provides weather forecast maps for the entire world, updated twice daily. Its products and services are intended to support the branding of its own clients. The following are on offer: standard forecasts, special reports, ski reports, marine forecasts, images, and maps. CustomWeather's forecasts and reports cover 58,000 cities via web-enabled phone or PDA, as well as by basic SMS.

The partners are: Vodafone (and hence Vivazzi), wcities, and VoltDelta Europe.

Map Data

Map Data involves the production of map data for use in geo-coding, navigation, and mapping.

Navtech

Founded in 1985 in California, Navigation Technologies Corporation is a provider of digital map information and related software and services. The map data is used in a wide range of navigation, mapping and geographic-related applications. The corporate headquarters are now in Chicago, but navigation systems in Europe using Navtech data are widespread.

On offer are services that provide:

- Maps
- Driving directions
- Turn-by-turn route guidance
- Fleet management and tracking
- Geographic information systems

These services are available over various platforms: self-contained hardware and software systems installed in vehicles; personal computing devices, including PDAs and cell phones; server-based systems, including internet and wireless services; and paper media.

Leading internet and wireless applications developers, service providers and handheld device manufacturers use Navigation Technologies' Navtech database: Garmin, Kivera, Motorola, PTV, and Webraska.

Tele Atlas

Since its foundation in the Netherlands in 1984, Tele Atlas has been a main supplier of geographic databases with detailed street level coverage. Tele Atlas is one of the market leaders in digital mapping. Its products span in-car navigation CDs, and B2B databases.

Tele Atlas and Ericsson are partnering with each other (Nov 2001). The agreement allows a set of geographic services, based on Tele Atlas's digital map data, to be made available to consumers all over the world via the Ericsson network platform. The service will be licensed to all businesses that offer access to location-based service information.

There are many partners worthy of note: Max.mobil, Mobilkom (in Austria); Webraska; Pocket-IT (in Norway); Whereonearth (in the UK) ; SignalSoft (in the US); Palmtopsoftware and Tom Tom maps (in the Netherlands); Mapquest.com Europe.

AND

Founded in 1984, AND is listed on the Amsterdam Exchanges. AND is a market leader in the provision of global data and access technology for travel planning, location and address management services and products. AND currently employs about 150 employees in its offices based in Germany, Ireland, India, the US and the Netherlands.

AND aims to provide its clients with industry leading solutions for international travel related planning, mapping, and address management. Its products are used in a broad spectrum of applications, varying from desktop software to mobile Internet services. AND's solutions to are used in customer relationship management, supply chain management, logistics and e- and m-business activities.

The current product offering includes:

- Global Databases - worldwide address and road data
- Clavis - for supplementing existing applications with AND's Global Address and Road data.
- AND Hosted Internet Services - for the management of company websites
- CD-ROM publishing - for both consumer and business markets in the area of travel and transport, reference and recreation.

Conclusions

Content and service provision can be classified according to 6 categories:

- Mobile Communities - relies on the notion of community-based channels for people with a mobile lifestyle
- City Guides - content about cities: tourist attractions, points of interest, and entertainment
- Directories - listings for businesses and services
- Games - location-based games
- Travel - applications for traveling: navigation and information
- Map Data - digital map data for location-based applications

The Frost and Sullivan report (Dec 2001) suggests that combining location-sensitive services with information tailored to users' individual interests offers lucrative opportunities for a range of possible market participants. The differentiation of services with content is likely to attract new users.

What kind of content is likely to be successful? Certain categories, such as the Travel and City Guides ones, rely heavily on the provision of content. Content has to be collected and aggregated. This can be extremely expensive, especially if the content has to be updated constantly.

Mobile Communities content, on the other hand, may require very little content to make an application successful. A good example is "Friend finder" applications. Such applications are aimed at the youth segment and reinforce the notion of convenient communication amongst peers. The crucial element in the service - the position of one's peers - is not dependent on content provision.

Though such applications might be earmarked for success there is one important reservation. The price of positioning someone at the present time may simply be too great for users to pay for it frequently. These "location pings" for each positioning effort may also put a lot of strain on the network.

GPS Receivers, Add-ons for Mobile Phones and PDAs

This section is divided into four sections: an overview, GPS receivers, GPS add-ons for standard mobile phones, and GPS add-ons for PDAs.

Overview: is GPS the Killer Application?

The Global Positioning System (GPS) is a worldwide radio-navigation system consisting of a constellation of 24 satellites and their ground stations. Originally for the purposes of the US military, these days scientists, sportsmen, farmers, soldiers, pilots, surveyors, hikers, delivery drivers, sailors, dispatchers, lumberjacks and fire-fighters make use of the location information provided by it. The question now is whether or not it will become something used by the masses in more everyday contexts.

GPS receivers have been miniaturized to just a few integrated circuits and are becoming very economical, making the technology accessible to a much wider audience. It was remarked once that GPS would become almost as basic as the telephone. That was before it actually was incorporated into a telephone. Garmin and Benefon are the two companies to date which have exploited this product combination.

The GPS phone example demonstrates how GPS technology has matured into a resource that extends well beyond its original design goals. It points the way, perhaps, to widespread adoption of the technology and applications which derive their usefulness from four factors: location, navigation, tracking and mapping.

The fact that there been a considerable amount of development in the field of GPS add-ons for standard mobile phones points to the rise in popularity of GPS. It may become a mass market technology "for regular folks" much sooner than anticipated. Such technology is expected to make its impact in Europe after it has been tested in the US market.

GPS Receivers

This section takes a look at the manufacturers of GPS receivers currently available in the marketplace. GPS receivers exist as dedicated devices as well as being incorporated into mobile phone handsets, and even watches.

List of Companies

- Benefon
- Garmin
- Lowrance
- Magellan
- Motorola
- Silva
- Sony Ericsson
- Suunto
- Trimble

Benefon

Based in Salo, Finland, Benefon was formed in late 1987. The introduction of Benefon's ESC! GPS phone nearly 14 years after the company's foundation (May 2001) is a milestone in the development of GPS technology. The GPS phone helps popularise GPS, exploiting a unique product combination. Benefon's products cover GPS for navigation, telematics and tracking.

In co-operation with MS Location, Benefon provides its customers with an interesting and controversial tracking service: you can authorize your friends and relatives to track you. There is also a special telematics GPS phone for organisations.

Ericsson is licensing its GPRS and 3G platform for Benefon's telematics handsets under development (Mar 2002). This agreement representative of Benefon's push to secure a leading global position in the growing mobile telematics market.

Cellpoint and Benefon are joining forces in assisted global positioning system services (Feb 2002). The agreement between the companies calls for a joint program to provide Assisted GPS (A-GPS) location solutions to GSM, 2.5G and 3G network operators this year.

Genimap and Benefon intend to enter the telematics market together (Feb 2002). The Benefon Track can easily be implemented for all emergency centers that can use voice and SMS for telematics. It is being marketed as a portable safety device for solitary workers and people at risk.

Benefon's service providers are: Genimap, Yellow Pages of Finland, Smstracker Finland, and Cyantel; its application partners are: Arbonaut, Cyantel, Genimap, MS Location, Novo Meridian, Orbis, Presentec, Datafactory, HP, Add2Phone, CT Motion, Trackmaster Telematics, ID Express, Teleprotect, and Nowire.

Garmin

Garmin was founded in 1989. With a lion's share of the market, this is one of the big players. Serving both the aviation and consumer markets, Garmin's products are used in flying, boating, driving, hiking and other activities. Garmin has three worldwide offices to provide customers and dealers with sales and service support: in the US, UK, and Asia

Garmin launched the first VHF/GPS handheld in July 1996, and in October 1998 launched the first GPS/cellular phone. There are currently four handheld GPS models on the market: GPS V, GPS III Plus, Emap and GPS 12MAP.

In addition, there is a GPS Phone, the NavTalk, which has just be updated and will be on offer in Europe (May 2002). The NavTalk II is an electronic organiser with WAP and will provide stiff competition for the Benefon GPS phone which has been on the market for some time. The NavTalk II features:

- Turn-by-turn directions and voice prompts
- Contact database
- Calendar
- Calculator
- Notes
- Tasks list
- Games
- Downloadable maps

Lowrance

Lowrance Electronics was founded in Missouri in 1957. Lowrance designs and manufactures sonar, GPS, mapping, and aviation instruments. Lowrance products are sold worldwide, through a wide variety of retail outlets including boat dealers, marine electronics dealers, aviation electronics dealers and sporting goods stores.

With over 1,000 employees worldwide, the Company manufactures half a million sonar and GPS/mapping units a year. Its GPS handset is called the iFINDER.

Magellan (Thales Navigation)

Magellan was founded in 1986 and merged with Thales Navigation in July 2001. Thales Navigation is a subsidiary of Thales, a leading European electronics company. Thales Navigation offers a variety of navigation and positioning solutions for consumers and commercial customers throughout the world.

Thales Navigation has incorporated Magellan's long legacy as a leader in the GPS industry. The successful Magellan brand name has been retained. Magellan branded products account for a large slice of the market. Six outdoor handsets are currently offered: the Meridian GPS, Meridian Gold, Meridian Platinum, MAP 330, and GPS 315, and GPS 310. In addition, for mariners, Magellan offers three GPS handhelds: the Meridian Marine, MAP 330M, and GPS 320.

Motorola

Motorola is looking for new ways of making its mobile handsets more appealing. It is now struggling to compete with Nokia in the handset stakes. Incorporating GPS might hold the answer.

SiRF Technology is forming an alliance with Motorola for the integration of SiRF's global positioning system technology into its iDEN(R) family of digital wireless phones (Mar 2002). This will location-enable the devices and meet the requirements for the FCC's Enhanced E911 mandate.

Silva

Silva was founded in the 1930s. It develops, produces and markets compasses and instruments. Silva's core activities consist of the design, manufacture and sales of magnetic compasses, electronic compasses, GPS and other electronic navigation equipment for outdoor activities.

Products made by Silva Sweden are sold under the Brunton brand name in USA and Canada. The Silva Multi-Navigator handset is the only GPS handset on offer at the moment.

Sony Ericsson

Sony Ericsson is introducing the T206 (Mar 2002), featuring Global Positioning System for emergency and location-based services. The T206 is the first Sony Ericsson branded CDMA phone for the Americas, and is scheduled for launch during Q3 2002.

The T206 promises a host of features for personalization, messaging and entertainment. These include screensavers, games and enhanced messaging services, in addition to GPS capability. The handset has a large, seven-line display and graphical menu interface. This marks an important development - the incorporation of GPS into a standard handset. It will be interesting to see if and when other handset manufacturers follow suit.

Suunto

In late 1999, Suunto was acquired by the Amer Group. The Amer Group is listed on both the Helsinki and London Stock Exchanges, and is a leading global supplier of sporting goods equipment. The Group's operations are based on global brands such as Wilson, Atomic and Suunto. Suunto's headquarters is located in Vantaa, Finland. Suunto manufactures dive computers and instruments, wristop computers, field and marine compasses and precision instruments.

As a navigational aid, the incorporation of GPS into a watch makes business sense. Suunto is planning the release of a GPS watch in the near future. This marks a stage in the popularisation of GPS.

Trimble

Trimble was founded in 1978 and is based in California. It has more than 2,000 employees in more than 20 countries worldwide. Trimble focuses on several key markets: Engineering and Construction, Agriculture, Fleet and Asset management, Component Technologies and the Military. In 1990, Trimble was the first GPS company to go public, offering stock on the NASDAQ.

Trimble Information Services offers internet location-based services for the mobile workplace (2001). New capabilities allow Trimble to offer complete end-to-end fleet management solutions as well as address the emerging market for location-enabled phones and mobile devices.

There is not a huge range of GPS handset receivers in the current product offering. Three are worthy of note: the GeoExplorer 3 System for GPS Mapping & GIS Systems, a GIS field device, and an asset surveyor.

Trimble's partners include: Siemens VDO, Infineon, Nortel and AutoDesk.

GPS Add-ons for Mobile Phones

This section takes a look at the manufacturers involved in the development of GPS add-ons for standard mobile phones.

List of Companies

- Airbiquity
- Chapman Technologies
- Nokia

Airbiquity

Airbiquity delivers Global Positioning System (GPS) data to wireless networks worldwide. In addition, they manufacture a GPS accessory that adds full GPS capabilities to existing wireless phones. This GPS Accessory is designed to fit Nokia the 5100, 6100, and 7100 series wireless phones in the US market, without modifications or upgrades to the existing phone. This is a very important step in the evolution of positioning technology, increasing the likelihood of mass market GPS.

Airbiquity is distributing its GPS Accessory to i-Planet Wireless, Entrust Connections, and Sky Cop to enable enterprise-based and consumer wireless location services (Oct 2001).

Its partners include: Axiom Navigation, InfoSpace, SignalSoft, SiRF Technology, Televigation, Televoke and WebTech Wireless.

Chapman Technologies

In another important development, Ericsson is adding location-based features to new phones by enlisting the help of Chapman Technologies. Chapman Technologies is hoping to cash in on the growing interest in high-tech gadgets through this deal with Ericsson. The company is developing GPS features for an add-on to Ericsson's new T60c mobile phone.

Chapman's President Laurence Sack has said that the complete system - the phone and the GPS add-on - will sell for about US\$300 throughout the US, Canada and Latin America (Oct 2001). This will undoubtedly popularise the notion of "GPS for regular folks".

Nokia

Shipments of the updated Nokia 9210i Communicator are expected to begin in Europe and Asia in Q2 2002. With the addition of a new GPS module accessory, Nokia is bringing GPS positioning technology to its range of mobile phones. It offers users a street-level address finder and route guidance for selected European cities.

This development is an important one, since the GPS module will encourage Nokia's partners to develop applications for location-based services utilizing GPS positioning.

GPS Add-ons for PDAs

This section is divided into two parts: an overview, and a list of companies which manufacture GPS add-ons for PDAs.

Overview: Personal Digital Assistants - Made for GPS?

In the 1980s, no-one went anywhere without their Filofax. By the end of the 1990s it had been replaced by its digital equivalent - the Personal Digital Assistant (PDA).

The allure of the PDA in the realm of business is not difficult to discern. Small, portable and powerful technology has always held great appeal, and for style-conscious users looking for the latest and in gadgetry, the PDA is the natural accompaniment to that other essential item: the mobile phone.

Most PDAs offer a spreadsheet, word processor, database, financial management software, clock, calculator and games. PDAs still require a "killer app" to make them truly ubiquitous. Does a Global Positioning System (GPS) functionality for navigation qualify as such an application? Combining the power and convenience of PDA devices with the intelligence and precision of GPS, these packages allow users to plan their trip, customise maps and directions, and track their progress, whether they are traveling by land, sea or air.

List of Companies

- Delorme
- Fastrax
- Geodiscovery
- Magellan
- Navman
- Nexian
- Pharos
- TravRoute

Delorme

Founded in 1976, DeLorme is a provider of mapping products and digital technologies primarily for consumer and business markets in the US. The company's bundle of software programs includes Street Atlas USA, and map software for routing. It works with Palm, Handspring Visor, and Sony CLIE handhelds. The Earthmate can also be connected to PCs and laptops, as well as PDAs.

Fastrax

Founded in 1999, Fastrax is a privately owned GPS technology company providing software and hardware solutions. It also provides consulting services for corporations implementing GPS capabilities into their products. Specialized in GPS receiver technology, it develops GPS receivers with a focus on mobile phones, sports instruments, and handheld computers.

Its Trax02 GPS receiver is roughly the size of a postage stamp. It claims ultra-low power consumption and low implementation costs. This could make GPS positioning technology in mass-market applications possible. The receiver is being tested with the Compaq iPAQ handheld.

Geodiscovery

GeoDiscovery is a private technology company based in Utah and founded in July 1998. Its Geode GPS module works for PDAs running the Palm OS. Maps of the United States are also supplied.

Magellan

As well as the standard GPS receivers, Magellan markets a GPS Companion for Handspring Visor and Palm V PDAs. The software supplied, MapSend Streets Europe, covers Austria, Belgium, Denmark, Ireland, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Navman

Navman is a manufacturer of marine electronics and Global Positioning System technology. Established in 1988, the New Zealand based company sells and supports its products on a worldwide basis through the company's distribution partners and support offices in New Zealand, Australia, UK and the US.

The Navman Mobile GPS system is available for the iPaq and Palm range of PDAs. Navman GPS kits are supplied complete with both SmartPath City and SmartPath Trip software for route personal location information and route planning. Twelve European countries and 90,000 cities are covered in five languages.

Tele Atlas is Navman's important partner. Tele Atlas, the digital map supplier, is partnering with Navman (Nov 2001) for B2B applications and B2C consumer products.

Nexian

US-based Nexian offers an array of GPS devices for industrial and commercial use. Nexian offers its HandyGPS Pro packaged with StreetFinder software provided by Rand McNally (Jun 2001). This unit is only designed to work on the Handspring Visor PDA. It uses detailed digital maps, showing the locations of nearby shops and attractions.

Pharos

Established in March 1998, Pharos is a high-tech company that has developed a street navigation and routing solution for PDAs. Pharos is based in the US but has a limited international distribution network.

Pharos provides the GPS receiver, software and maps as a package. The Pharos Pocket GPS Navigator is for pocket PC-based PDAs and Palm OS-based PDAs, and provides consumers with street-level routing and navigation.

Its notable partners are SiRF and Qualcomm.

TravRoute

US-based TravRoute develops navigation and mapping solutions for business and consumer markets. TravRoute delivers turn-by-turn directions, real-time mapping, real-time travel information for drivers. Its Pocket CoPilot 2.0 runs on the following pocket PC handheld ranges: Casio Cassiopeia, Compaq iPAQ and Hewlett-Packard Jornada.

Conclusions

The miniaturization of GPS receivers to just a few integrated circuits and lower prices is making the technology accessible to a much wider audience. It is becoming a mass market technology "for regular folks" much sooner than anticipated. We are on the threshold of widespread adoption of GPS technology - for mobile phones, PDAs and even watches.

Garmin and Benefon the two companies to date which have exploited the GPS phone product combination. Garmin is launching its NavTalk II phone in the very near future, upsetting Benefon's dominant position in Europe (Mar 2002). SiRF Technology is forming an alliance with Motorola for the integration of SiRF's GPS technology into its iDEN(R) family of digital wireless phones (Mar 2002). As if that was not enough, Sony Ericsson is introducing the T206 (Mar 2002) in the fall, featuring GPS for emergency and location-based services.

In addition to these GPS phones, there is now a range of GPS add-ons for standard mobile phones. In the US, Airbiquity is providing an add-on for Nokia phones. Chapman technologies is developing its GPS add-on for Ericsson's new T60c mobile phone. Shipments of the updated Nokia 9210i Communicator are expected to begin in Europe and Asia in Q2 2002. With the addition of a new GPS add-on, the Nokia Communicator is also moving into a new phase.

With GPS packages for PDAs, users can plan their trip, customise maps and directions, and track their progress, whether they are traveling by land, sea or air. The precision of GPS reinforces the power and convenience of PDA devices. These packages can be taken anywhere and compete with much bulkier systems used for in-car navigation. PDAs with GPS add-ons severely threaten car manufacturers and their system integrators for vehicle navigation.

All these developments taken together will encourage mobile operators to consider the evolutionary path for positioning technology. They may leap from Cell-ID methods straight to the adoption of GPS, foregoing E-OTD completely.

Location Technology Developers

This section is divided into five parts: an overview, positioning technology vendors, middleware vendors, LBS application vendors, and the conclusions.

Overview: the Evolutionary Path for Positioning Technology

Precise location knowledge was once heralded as the competitive advantage for mobile network operators. The situation then changed somewhat. High accuracy was no longer thought to be the key differentiator of applications in an increasingly crowded market. This has been the case especially in Europe, where considerations of value for money and enhancement of mobile operators' existing services have taken priority over accuracy. There is no governmental mandate in Europe as there is in the US, hence the commercial standpoint has been foremost in the minds of the European operators.

Network-based positioning solutions promised to be cheaper since they did not, it was claimed, require modifications to existing handsets. On the other hand, GPS handsets required the incorporation of new hardware and software updates at additional cost. Hence, the increased accuracy came with a price. The competitive dynamic is now shifting. GPS chips are becoming cheaper and more widely available. GPS handset based solutions are therefore beginning to demand serious consideration from European mobile operators. Not so long ago it had been thought that only the high-end market segments would use GPS technology, and it was not envisaged as a mass market application.

Recent developments have pointed to the beginnings of widespread adoption of GPS and Assisted-GPS (A-GPS) technology. GPS add-ons for standard Nokia and Ericsson mobile phones in the US, as well as for PDAs, will go a long way towards popularising the technology. Europe is bound to catch up sooner or later, destroying the notion that GPS is a phenomenon confined to the other side of the Atlantic. Despite the increase in popularity, GPS may flounder over the issue of battery life. GPS receivers are a considerable drain on batteries. Constant recharging may not fit in with users' perception of a mobile lifestyle.

What will happen to E-OTD technology? E-OTD technology was often described as an intermediate stage in the evolution of technology, a half-way house between Cell-ID positioning methods and GPS. It offered increased accuracy of 60 - 200 metres, as opposed to 100 - 1000 for Cell-ID methods, and only required basic software modifications to the mobile phones themselves. However, it simply did not make sense for mobile operators to recall existing mobile phones from subscribers to update the software. As a result E-OTD vendors are now concentrating their efforts on integrating the software into new phones which is not without its own difficulties.

The question that needs addressing by mobile operators right now is: will it be more profitable to skip the intermediate phase and simply implement GPS technology? It looks likely that many will simply continue to use the positioning technology they have at their disposal at the moment, adopting a "wait-and-see" policy until the market situation is clarified.

Positioning Technology Vendors

This section considers vendors of positioning technology: Cell-ID, E-OTD and handset-based (GPS or A-GPS).

List of Companies

- Cambridge Positioning Systems (CPS)
- Cellpoint
- Ericsson
- Kipling
- Lucent Technologies
- Motorola
- Nokia
- SiRF
- Snaptrack
- Sonera

Cambridge Positioning Systems (CPS)

CPS is located in Cambridge, England as well as in the USA, Singapore, Hong Kong, China and Australia. CPS is a venture and corporate funded company and its investors include: 3i, Ericsson, GSM Capital, Infineon, Intel, and Siemens. CPS has received \$32 million of third round funding which included Ericsson and Intel (May 2001).

CPS has already licensed its Cursor E-OTD solution to major network equipment vendors and handset manufacturers - including Ericsson, Siemens and Nokia. Endorsed by many US GSM operators as the technology to meet the FCC E-911 mandate, E-OTD hopes to be the first high-accuracy network deployed. Cursor claims to deliver accuracy results of 50 metres on GSM networks, with even greater accuracy predicted for 3G.

The outlook looks bright for CPS considering some very recent developments. Siemens IC Mobile and CPS are cooperating to support Siemens IC Mobile's development of mobile location solutions (Feb 2002). This five-year deal involves CPS licensing its software to locate mobile phone handsets within mobile networks. CPS is providing E-OTD software integration for Siemens handsets. This enables the rollout E-OTD enabled location-based network equipment and handsets in the US and other markets.

Pocket-IT and CPS are showcasing high accuracy positioning for 'games' and 'find the nearest' services (Sep 2001). Lucent Technologies and CPS are partnering to supply high accuracy location-based service solution for GSM mobile networks (Jun 2001). CPS and Ericsson are in a commercial licensing agreement for CPS's Cursor mobile positioning system (Jun 2001). Another interesting strategic partnership is with Gravitte, on the mobile location services side.

Its partners are: Ericsson, Gravitte, Lucent, Nokia, Pocket-IT, and Siemens.

Cellpoint

Cellpoint was founded in February 1997 as Technor but later changed its name to CellPoint (Oct 1999). The company employs 76 people in Sweden and the UK and is a public company, listed on the NASDAQ as well as in Sweden.

CellPoint's third-generation location platform is an end-to-end service delivery engine, consisting of two parts - the Mobile Location System and the Mobile Location Broker. Cellpoint's roadmap incorporates the belief that many mobile handsets around the world will have A-GPS built-in. According to Cellpoint, A-GPS and Enhanced-Cell-ID cover all the bases. Other positioning techniques beyond this combination are quite redundant. Cellpoint uses SiRF's A-GPS technology in its location technology platform.

Cellpoint hopes the combination of its E-Cell-ID solution with A-GPS will give consumers the 'best of both worlds'. The roadmap involves CellPoint's E-Cell-ID in the short-term, and then when the handsets are widely available, a combined E-Cell-ID/A-GPS solution. If these A-GPS handsets materialise on the scale envisaged by Cellpoint, this is a powerful proposition to operators and the end-users of location-based services.

How has Cellpoint been doing in the implementation of its roadmap? CellPoint is partnering with Benefon for an A-GPS solution (Feb 2002)(see GPS handset section under Benefon for details). E-Plus uses CellPoint's Mobile Location Broker as its location middleware platform (Nov 2001).

Cellpoint's industry-wide partnerships include those with: Airflash, Benefon, Unwiredfactory, SiRF, Orange France, Oracle, It's Alive, Infospace, Eurotel, E-plus, Tele2, and Webraska.

Ericsson

Ericsson's Mobile Positioning Center supports several positioning methods, single cell timing advance, GSM cell-based location, (CGI + TA), enhanced observed time difference (E-OTD), and assisted GPS (A-GPS). This strategy rules out nothing - a "wait and see" policy for the various positioning technologies.

Ericsson has revealed nine operators who had chosen its Mobile Positioning System (Feb 2002). Twenty commercial contracts have been signed with operators, in addition to operators who have agreed to trials. Hence, there are operators not on the list who have its Mobile Positioning System.

The public list includes: AIS, Thailand; Amena, Spain; Eircell, Ireland; EMT, Estonia; FET, (Far East Tone), Taiwan; Orange, France; Telenor Mobil, Norway; Telia Mobile, Sweden; Turkcell, Turkey.

Kipling

Kipling's business concept is to supply products, platforms, services and integrated solutions for telecom operators and providers on a global market. In addition, Kipling supplies software systems and consulting services to the telecom sector. The group has six subsidiary companies in Sweden, the United Kingdom and Brazil. Its objectives for 2003 are to secure leadership in selected Swedish market segments, and obtain a global market share of 20% in positioning platforms.

Kipling is now supplying its updated network-based GSM positioning platform and is working with the Swedish operator, Europolitan (Feb 2001). Kipling and Telecorreio, a mobile portal builder, are cooperating in Portugal (Oct 2000).

Lucent Technologies

Lucent Technologies is a global player. Not banking on any particular positioning technology, Lucent Technologies claims support for all major positioning technologies. Lucent's Wireless 9-1-1 service supports all of them.

However, Lucent has had a long-standing interest in GPS. SyChip, a Lucent Technologies venture, is developing the world's smallest fully integrated Global Positioning System (GPS) module (Nov 2000).

Lucent Technologies and Cambridge Positioning Systems are working together to supply high accuracy location-based service solution for GSM mobile networks (Jun 2001). The agreement gives Lucent the capability to develop high-accuracy, location-determination platforms by integrating CPS's Cursor technology into its network infrastructure products.

Motorola

Since 1985, Motorola has been a world leader in the development of GPS products and is continuously developing GPS products for consumer, transportation, wireless and precise timing applications. Motorola's GPS products are used in the company's cellular communication and positioning solutions for the automotive marketplace, including emergency and telematics products.

Nokia

Nokia has long recognised that location-based services enable substantial operator revenue increases. Its patented Nokia mPosition works with all existing handset terminals.

However, an evolutionary path allowing for various contingencies to E-OTD, A-GPS and 3G/IP-RAN solutions has been mapped out. Nokia is able to deliver whatever becomes the prevalent positioning technology.

Fujian Mobile Communications of China uses Nokia's mPosition for its mobile location services (Feb 2002). Nokia's Chinese joint venture is one of the leading companies in China for mobile data services. Nokia is now offering its new mobile positioning systems (Nov 2001). New additions to the Nokia mPosition solution strengthen current location-based services, while extending location-based services to 3G.

SiRF

US-based SiRF Technology was founded in February 1995. SiRF's GPS technology is in evidence in car navigation systems, portable PCs, cellular phones, entertainment systems, and hand-held devices.

Its operations are focused on four main areas:

- Wireless Handheld Products - E911 for cell phones, location aware security devices, child and personal locators, asset trackers
- Automotive Products - car navigation systems, car security systems, telematics systems, fleet tracking systems
- Mobile Computing Products - PDAs with GPS, Compact Flash GPS peripherals, Laptop PC's with GPS
- General Consumer and Marine Products - handheld GPS products for outdoors, sports watches with embedded GPS, marine navigation GPS systems, location enabled digital cameras

SiRF is also responsible for the production of GPS chips, integrated circuits, software and toolkits. It is supplying Sony Ericsson with GPS Technology for fleet Management and telematics (Mar 2002).

Its partners are: Airbiquity, Aisin, Borg, Clarion, Conexant, Sony Ericsson, Hitachi, Intel, Motorola, Matsushita Group, NEC, Nokia, NTT DoCoMo, and SignalSoft.

Snaptrack

A Qualcomm subsidiary, Californian-based SnapTrack was founded in 1995 with the aim of making personalized, high-quality location services. The company's wireless A-GPS products include the SnapSmart location server software system, the SnapCore multimode GPS solution, and the SnapWARN GPS reference service. SnapTrack is in commercial agreements with major wireless chipset vendors that provide most of the wireless modem chipsets to the industry.

Its products serve a lot of the major Japanese operators. Japan is seeing the beginning of mass market deployments of wireless A-GPS (Q4 2001). Snaptrack claims 60% of all US operators have opted to use A-GPS, including leading operators like Sprint PCS, Leap, and Alltel. SnapTrack and SignalSoft are jointly marketing and delivering location-based applications and systems to wireless carriers and service providers (Feb 2001).

Its partners are: Compaq, CTC, Denso, Motorola, NEC, Neolink, NTT DoCoMo, Phone.com (Openwave), SECOM, SignalSoft, TechnoCom, and Texas Instruments.

Sonera

Up until Q3 2001, Sonera was marketing its positioning platform and range of location-based applications across the world to other mobile operators. A partnership program was also in existence for the development of new services with third parties. Sonera still has the capability to deliver its technology and location-based applications, but it is not currently marketing them. The only information that it will provide is that it is "currently reorganising" its activities.

Middleware Vendors

This section considers vendors who provide "middleware". This can be defined as the technology, usually software-based, which allows the positioning technology to be integrated with the location-based applications. The software technology is designed to interface with any positioning technology, whether it be network-based or handset-based.

List of Companies

- CT Motion
- Mobilaris
- MS Location
- SignalSoft
- Telecommunication Systems (Xypoint)
- Xmarc

CT Motion

CT Motion's core product is the Celebriety Location-Based Services management platform, enabling the creation and management of location-based services. Key applications delivered to the market by CT Motion include M-Commerce services such as Mobile Yellow-Pages and M-Coupons (Mobile Coupons) as well as Mobile Workforce Management for the corporate market.

CT Motion and Webraska are teaming up to provide CT Motion's M-Coupons application, City Beat. This will be enhanced by Webraska's Personal Navigation API, including mapping, routing and spatial searching functions (Feb 2001). CT Motion and Benefon are partnering to deliver high accuracy location services. Successful trials have been accomplished and the pair are now seeking to sell the solution to mobile network operators around the globe (Feb 2001).

The list of partners includes: Orange, Benefon, Ericsson, Compaq, Webraska, ESRI (mapping software), CPS, Sigma-1.

Mobilaris

Mobilaris develops and markets middleware and location-based services for the mobile Internet. Its main product is Pacific Ocean, a service enabling middleware, that functions as a layer between the end-user services and the subservient systems. Different databases can be connected to Pacific Ocean, for example, content and GIS databases. The idea is that the platform allows owners of location-based content to efficiently distribute their information to a variety of mobile devices through the middleware. Mobilaris is integrating real-time map data from Navtech in this way (Feb 2002).

Another type of content is being integrated in the same fashion (Jun 2001). Yellow Pages Near You, an application developed by Mobilaris, is provided Telia Mobile net. Leading Norwegian wireless operator, Telenor Mobil, is working with Mobilaris who provides its mobile internet service middleware for location-based services (Apr 2001). The Mobilaris service middleware Pacific Ocean is delivered with Ericsson's Mobile Positioning System as part of a larger location-based project between Ericsson and Telenor Mobil.

Its customers are: Telia, Telenor, and Eircell/Vodafone. The strategic partners are: Ericsson, Webraska, Compaq, Oracle, and Sun Microsystems. On the applications side, the developers are: It's Alive, Unwiredfactory, smallplanet, Parking Partners, Cell network, Starcus, Pocket-IT, Bozoka.com, and isMobile.

MS Location

Founded in 1994, MS Location is a privately-held company owned by its founders and venture capital companies 3i Finland and Forifina Oy. Its main office is in Lappeenranta, Finland. It offers location-positioning solutions to wireless communications service providers, professional users, and private end-users.

Its Mobile Location Service (MLS) Platform called Nexus supports various positioning methods, ensures user privacy, and provides standard Application Programming Interfaces (API) for third-party developers. It enables positioning services for mobile carriers and service providers. The technology can support applications ranging from the tracking of fleets, people and shipments to quick searches for nearby products, services and other location-based information.

MS Location is supplying its MobiNex Tracking System to STORA ENSO (Mar 2002), and Radiolinja is receiving complementary technology from MS Location for its own location-based services (Feb 2002).

Its partners are: Benefon, Nokia, Hewlett Packard, Radiolinja, and 3i.

SignalSoft

SignalSoft Corporation's software suite allows mobile operators to provide location-based services to their subscribers. Though US-based, SignalSoft is making huge inroads where the European market is concerned. Over 40 million calls to emergency authorities are made from mobile phones in Europe every year, and SignalSoft is responding to future EU requirements.

SignalSoft is showcasing the latest version of its mobile emergency services software solution, SafetyFirst, for the GSM market (Feb 2002). SafetyFirst enables GSM mobile operators to meet EU requirements for emergency services to provide a single European emergency call number (112). The Directive states that all end users must be able to call emergency services free of charge by using 112 and that public telephone networks need to make caller location information available to authorities handling emergencies.

SignalSoft and Webraska are offering a complete location-based services solution with privacy and geospatial functionality as part of a reseller agreement (Jan 2002). SignalSoft is also partnering with French mobile operator SFR (Cegetel Group) for the delivery of its location-based services (Dec 2001).

In a market where mobile penetration is low, Siemens and SignalSoft are cooperating with PTC-Era to enable location-based services in Poland. mobilePosition, a SignalSoft company, provides friendPosition to Swedish mobile operator Telia - marking an interesting new phase in the type of location-based services on offer there (Nov 2001).

SignalSoft has forged partnerships with more than 250 leading companies in the wireless location-based services industry. Partners include: AT&T Wireless, Cegetel/SFR, Libertel/Vodafone, Orange, PTC-Era, Sprint PCS, Sunrise, Telia Mobile, Vodacom, and VoiceStream.

TeleCommunication Systems (Xypoint)

TCS is headquartered in Maryland in the US and has been a public company since 2000, traded on the NASDAQ. Though based in the US, it has just opened an office (Feb 2002) in London, its headquarters for Europe. TCS's London office will provide operations and deployment support for the company's existing Xypoint Location Platform and Wireless Internet Gateway customers. TCS has signed three additional carriers for the wireless E9-1-1 location service, bringing the total to 7.8 million active subscribers (Oct 2001).

TCS is a technology provider to carriers worldwide including Vodafone, Verizon Wireless, VoiceStream, Telefonica and Qwest. Motorola, Kivera, AirFlash, and 724 Solutions top the list of 30 charter member companies that have joined the Location Platform application developer partner program since its launch at the end of June 2001.

Xmarc

With its feet firmly in the B2B sector, Xmarc provides infrastructure software solutions for wireless and internet-enabled companies that need to manage location-based data. Xmarc's software platform enables routing, proximity searching, geo-location and map rendering functionality to numerous client devices. J-Phone in Japan uses Xmarc's WIISE platform.

Xmarc and Airbiquity are teaming up to provide AXLE (Airbiquity-Xmarc Location Environment). AXLE is designed for the deployment of GPS-enabled routing, fleet management, asset tracking and roadside assistance services (Jun 2001). The platform is jointly marketed to mobile network operators, roadside assistance organisations, call centres and the logistics and transportation markets. Xmarc and Navigation Technologies are working together to integrate Navigation Technologies' digital mapping content for North America and Western Europe with Xmarc's platform WIISE (Apr 2001).

Its partners are: Airbiquity, Navtech and J-Phone.

LBS Application Platforms

This section covers companies which offer application platforms for location-based services. In order to bring these applications onto the market, platform vendors need to cooperate with the vendors of positioning technologies.

List of Companies

- Arbonaut
- mobilePosition
- Siemens
- Webraska

Arbonaut

Founded in 1994, Arbonaut is a Finnish company developing mobile location services technology for mobile operators, mobile phone manufacturers and other mobile portal builders. Its principal product is the Arbonaut GeoMessaging Suite.

The Arbonaut GeoMessaging Suite is an application platform for location-enhanced messaging. It allows users to automatically incorporate location into messages. Location information is converted into an appropriate format for each media or terminal type during the transmission. Supported media includes email, SMS, Smart Messaging and WAP. GeoMessaging has been marketed at operators to enhance their messaging applications which include personal navigation, mobile yellow pages, chat and virtual communities.

Its partners are: Aplicom, Benefon, Hewlett Packard, IBM, Radiolinja and 3i.

MobilePosition

mobilePosition, founded in 1999, was acquired by US-based SignalSoft in May 2001. It develops applications and technical solutions for location-based services. The company provides its applications to operators and portals.

In addition, mobilePosition has developed its own technical platforms which operate on Web sites (HTML), mobile portals, and via short message service. Its scaleable MLS platform allows the development and launch of third party location-based services. Its own applications include: friendFinder, bikePosition, yachtPosition, housePosition and weatherPosition.

Its partners are Telia and SignalSoft.

Siemens

Siemens offers a suite of location-based services products including a location platform, a location enabling server, a geoinformation system and a range of applications. The location platform supports future migration to high-accuracy positioning methods including enhanced Cell ID, E-OTD, and A-GPS.

Its m.traction Location Dependent Services include:

- m.traction Finder - location-based yellow pages
- m.traction Friends - finding the closest friends
- m.traction LocalAds - location-based advertising and information services
- m.traction Resource Control - fleet tracking and supervision application

Webraska

Webraska provides solutions to mobile operators, application developers and telematics service providers seeking ready-to-launch location-based applications and services. Webraska has strengthened its market position via a merger with AirFlash, a provider of applications for network operators and wireless service providers (Sep 2001).

Webraska's applications platform consists of three products:

- SmartZone Applications Platform - integration capabilities for provisioning, subscriber profile, publishing, and contextual relevance.
- Webraska SmartZone applications - allows wireless network operators and wireless service providers to deploy Yellow Pages, POI Finder, Maps, Directions and Community location-based wireless services, supporting multiple devices.
- Webraska SmartSMS applications - provides location-based Yellow Pages, POI Finder, Directions and Community Services to SMS users.

It is working with the following mobile operators: Blu, Telecom Italia Mobile, Viag Interkom, and Vivazzi (the Netherlands). Its technology partners are: Cambridge Positioning Systems, Cellpoint, Ericsson, IBM, In-Fusio, Nokia, Oracle, SignalSoft, Voxmobili and Xypoint. Map data is supplied by Tele Atlas, and Navigation technologies.

Conclusions

Not so long ago GPS was not envisaged as a mass market application. However, GPS handset based solutions are now beginning to demand serious consideration from European mobile operators. Many European operators are asking whether it would be best to implement GPS technology straight after the Cell-ID stage. This would make E-OTD technology redundant.

In practice, many operators will adopt a "wait-and-see" policy until the market situation is clarified. There is no rush to implement GPS technology since many location-based applications do not require high accuracy positioning. GPS receivers are also a considerable drain on batteries. Constant recharging may not fit in with users' perception of a mobile lifestyle.

Whatever the fate of E-OTD technology, the future is bright for "middleware" and location-based applications vendors. Middleware technology is designed to interface with any positioning technology, whether it be network-based or handset-based. LBS applications vendors are similarly well placed. They make up an essential component of the value-chain - without applications there can be no business.

Vehicle Navigation

This section is divided into three parts: an overview, the automotive industry: system integrators, after-market installations, and navigation using mobile phones.

Overview: The In-Vehicle Navigation Market

Early in 2001, Strategy Analytics conducted an end user survey consisting of 1000 interviews across the US and Europe. The survey concentrated on the potential demand and price points for a wide range of emerging telematics, navigation, traffic information and in-car entertainment applications and features.

Some of the key findings were: firstly, US users have a much stronger propensity to pay for in-vehicles safety features than European users, and a stronger willingness to pay for entertainment in the car. The majority of respondents also indicated a total "realistic" monthly spend on telematics services of up to \$15 per month. Secondly, Emergency and roadside assistance services have a very high value proposition as 52% of European respondents and 61% of US respondents are willing to pay for such services. Thirdly, at current prices, stand-alone navigation systems will not become widely adopted in mainstream car ranges in Europe and the US.

The steep growth in telematics services that research firms have been forecasting for several years has not materialised. According to the Strategis Group, telematics growth could still be catalyzed, if car manufacturers and wireless operators partnered to introduce elegant, hands-free voice solutions into cars by using emerging technologies such as Bluetooth and speech recognition. Hardware and airtime costs will decrease as telematics is introduced to a wider segment of consumers and in more mass-market vehicles.

One major obstacle is that car buyers are not willing to pay for expensive embedded safety hardware and services that they hope will never get used. Nevertheless, both the supply-side and demand-side trends driving the original growth projections may still be valid. Consumers display solid interest in safety-related telematics applications and telematics are quickly becoming standard as part of a bundle of options in luxury cars.

Anecdotal evidence from some of GM's competitors claims that only two-thirds of OnStar equipment is ever activated on its vehicles, despite the fact that the service is free for one year. It is understandable that car manufacturers are asking questions such as: what is the real potential for telematics to drive future vehicle sales, and what effect will emerging and converging technologies have?

The Challenge Posed by the Wireless Operators

Wireless operators are now focusing some attention on the automobile. They have several important advantages compared to car manufacturers: they know how to operate an on-going service business, and know how to manage monthly billing provisioning - a deceptively complicated and costly matter. The competitive dynamic may shift further in favor of wireless operators as new high-performance "smartphones" and PDAs become widespread and carry services delivered over more sophisticated 2.5G networks.

Emergency safety services and hands-free voice both have a high perceived consumer value, according to Delphi Automotive research, but consumers are reluctant to pay much for emergency services because, understandably, they never hope to use them.

Driver distraction is an increasingly heated topic that will not go away. Driving in the car is not like sitting at a desktop, so telematics services must be performed with a limited amount of button pushing or even serious concentration. Legislation may have the final say, to the detriment of the wireless operators. The car phone controversy began in New York State when it passed a law banning the use of handheld phones in cars some time ago. Similar laws may eventually be passed in Europe.

This was welcomed as a potential windfall by car manufacturers and their suppliers. As engineers struggle to defeat the problem of driver distraction, the industry is charging forward with plans to build advanced telematics systems.

The Automotive Industry: System Integrators

The following list of automotive OEMs providing integrated in-car navigation systems all make use of GPS technology. In the US, Motorola is a key supplier of the telematics technology. In Europe, Siemens is the main supplier of the technology for Mercedes and BMW.

List of Companies

- Wingcast Mobility
- OnStar
- Renault
- Nissan
- Mercedes
- BMW

Wingcast (Ford)

Wingcast is a joint venture formed by Ford Motor Company and QUALCOMM, created in July 2000. Wingcast partners with a variety of companies which deliver content and applications via the Wingcast portal. The plan is that services will eventually be accessed using existing digital communications networks (through carrier partnerships) via a hands-free, voice-activated interface inside vehicles, and via other hand-held devices while outside the vehicle.

The current OEM customers include Ford and Nissan. On the technology side there are partnerships with: Amdocs and Ericsson (for billing and mediation for applications and services), Sun Microsystems and Oracle. In addition, Airbiquity supplies telematics technologies. Map data is supplied by Navtech.

OnStar (GM)

OnStar, founded in 1995, is a collaboration between General Motors, EDS and Hughes Electronics. It now has 1.5 million subscribers and is growing at a rate of about 5,000 subscriptions per day by, according to GM (Sep 2001). OnStar services are available in the United States, Canada, and Europe.

Using GPS, OnStar offers driving directions, emergency assistance, stock quotes, and email in vehicles. This range of services now includes weather provided by Weather.com. This service offers current weather conditions, extended forecasts and severe weather alerts for a vehicle's current location (Jan 2002). Other services worthy of note are: stolen vehicle tracking, trip planning and reservations for hotel and events.

Carminat (Renault)

Carminat, an integrated Navigation & Guidance System was first introduced on the Renault Safrane in September 1995. The Carminat system uses the Navtech database. Renault is a shareholder of Navigation Technologies (Navtech) and has been involved with Navigation Technologies since the creation of the European company EGT, now called Navigation Technologies Europe.

A Renault-Nissan alliance was signed in March 1999, with Renault acquiring an equity stake in Nissan.

Infiniti (Nissan)

Infiniti, Nissan's luxury-vehicle division, unveiled telematics through the Infiniti Communicator program in April of 1998. The GPS navigation system offers a colour screen, route optimization, and turn-by-turn directions. A list of nearby services includes: gas stations, ATMs, Infiniti dealers, hospitals, universities, bowling allies, and ice skating rinks and many other categories.

Tetra-Star (Mercedes)

The Mercedes-Benz Navigation System was designed by Siemens Automotive and is based on modern GPS technology. Called Tetra-Star, the navigation system offers vehicle tracking, a color map, turn-by-turn voice instruction, route calculation and a list of alternate routes, and a database of service locations such as hotels, restaurants, and emergency services.

BMW

This is also based on Siemens technology and offers the same features as the Mercedes-Benz system.

After-Market Installations

This section considers companies which manufacture in-car navigation systems which are fitted at some point after the car has left the factory. The section is broken down into two parts: combined in-car navigation entertainment and navigation systems, and dashboard-mounted systems.

Combined In-Car Entertainment and Navigation

This section looks at the companies that produce systems that combine the concepts of in-car navigation with in-car entertainment.

List of Companies

- Blaupunkt
- Clarion
- Kenwood
- Panasonic
- Pioneer
- Siemens VDO

Blaupunkt

Blaupunkt is part of the Bosch group. Blaupunkt markets its navigation system as part of the in-car multimedia experience. It offers the TravelPilot range of in-car navigation and route guidance systems using GPS and CD-ROM based maps. This system provides the driver with directions via a display or spoken directions.

Clarion

Clarion had its beginnings in 1940, when the Hakusan Wireless Electric Company began to manufacture and sell battery-operated radios for household use. The company launched the Clarion brand in 1947, and then became the first car radio maker in Japan around 1948.

In 1995 Clarion began exploring the idea of car multimedia. Since then, Clarion has integrated audio, video, entertainment, navigation, and communication features into a comprehensive system. The navigation system is based on GPS. Its JoyRoute system uses visual and voice turn-by-turn guidance.

Clarion also uses Navtech map data.

Kenwood

The head office of Kenwood Europe is in the Netherlands. In 1992, Kenwood began marketing the car-navigation system, and in 1999, introduced a DVD Navigation system. There is a special R & D centre for navigation and software development.

The main features of its combined audio and DVD navigation system are: alternative route options, stored locations, audible and visual guidance, and points of interest.

Siemens VDO

The companies Siemens Automotive and Mannesmann VDO formed a partnership to merge their respective areas of long-established expertise. The new company Siemens VDO Automotive AG started work in April 2001.

Siemens VDO currently offers five in-car navigation systems. Features include: up-to-date traffic information and alternative route calculation. There is a choice of icon or voice guidance. Integrated systems include the navigation system itself, and a radio and CD player. There are around 20 digital road maps, and almost the whole of Western Europe as well as the USA and Australia are covered. The system uses VDO Dayton software for maps.

There is cooperation with both Navigation Technologies and Tele Atlas, two leading manufacturers of digital maps (Mar 2000).

Panasonic

Panasonic has been operating in Europe since 1962, when it established its first sales office in Hamburg, Germany. Panasonic now employs nearly 15,000 people in manufacturing, sales, R&D and support companies throughout Europe.

Panasonic is another company which combines different devices into one unit. DVD navigation, video CD, and music CD are available on the same device. Navtech is the supplier of the map data, and maps for all of Europe are available on a single DVD.

Pioneer

In 1990, Pioneer introduced one of the world's first GPS car navigation systems. In 1997, it began producing DVD car navigation systems. Pioneer currently offers seven DVD navigation packages.

The top-of-the-line navigation package has an LCD colour display with built-in DVD player for watching movies, a navigation unit and an audio unit. The navigation system allows points of interest search for places such as restaurants and golf courses, and locates nearby services such as petrol stations.

Pioneer uses Navtech map data.

Dashboard Mounted

This section looks at the companies that produce dashboard mounted in-car navigation systems. These devices can often be moved from one vehicle to another without too much effort.

List of companies

- Garmin
- Magellan

Garmin

Garmin manufactures a dashboard mounted GPS navigation system with voice turn-by-turn directions. A colour LCD display on some models shows the locations of the nearest highway exits, gas stations, restaurants, ATMs, hospitals, and rest areas.

The current product offering includes six different variations: StreetPilot III, GPS V, GPS III Plus, GPS 12MAP, StreetPilot, and StreetPilot Colour. Navtech supplies the digital map data. Navtech is supplying digital map data to Garmin to power navigation systems designed for a specific line of 2002 BMW motorcycles (Jan 2002).

Magellan

Magellan offers the 750 series of GPS Vehicle Navigation and Driver Information Systems, representing its fifth generation of navigation products. Turn-by-turn navigation is a standard feature. The 750M model is designed to be more portable. Navtech supplies the digital map data.

Navigation Using Mobile Phones

This section looks at in-car navigation systems developed for use with standard mobile phones, or for standard mobile phones with GPS add-ons.

List of Companies

- Yeoman
- Siemens

Yeoman

Yeoman is based in the UK and is listed on the London Stock Exchange. Yeoman's business has been in the nautical navigation industry since the 1980's. However, a few years ago it developed a core strategy to exploit the new market opportunity of delivering land-based navigation to a mobile phone. It is this market that Yeoman believes presents the company with the most substantial growth and revenue potential.

Its product is representative of a new breed of navigation services using conventional GSM handsets.

Yeoman claim the launch of the world's first traffic and navigation service for conventional mobile phones (Dec 2001). The service delivers route planning, traffic information and turn-by-turn directions by voice. The service, called VoxNav, allows the calculation of a driver's route to be performed entirely off-vehicle at a central server meaning that existing GSM phones can be used. Instructions are delivered using text to speech technology.

Siemens

There is a GPS accessory for the ME45, S45 handsets - the Car Kit GPServicePilot for in-car navigation.. The actual position of the car is determined by satellite and the GPS-GSM dual band combi-antenna. Telematics services are available in Germany, England, and Austria. These include: route optimization, traffic information, a breakdown service, and an SOS & 112 service.

Navigation Using PDAs with GPS Add-ons

Please refer to "GPS receivers, Add-ons for Mobile Phones and PDAs" under the section "GPS Add-ons for PDAs" for a list of companies.

Using a PDA with GPS for in-car navigation clearly poses a threat to the other technologies employed in this field for the same purpose. PDAs are highly portable, whereas the system integrators and after-market installations are not. The dashboard mounted devices, and mobile phones with GPS add-ons offer a much higher degree of portability and therefore represent the nearest competitors.

The degree of portability may well be the crucial factor in the battle of the technologies staged over the next few months.

Conclusions

The Strategis Group believes telematics growth could still be catalyzed, if car manufacturers and wireless operators partnered to introduce elegant, hands-free voice solutions into cars. However, it is unlikely that such technology will ever filter through to cars at the lower end of the market. Car buyers are not willing to pay for expensive embedded safety hardware and services that they hope will never get used. Luxury car buyers may be able to justify the purchase of such equipment, but it is unlikely to influence their decision to buy a particular model in the first place.

After-market installations are fond of pairing in-car navigation with entertainment. In the mind of the buyer, the fact that a navigation system comes with in-car entertainment may justify its purchase. Once again though, these installations are embedded into the car itself - they may be removed and reinstalled in another car but they are fairly permanent.

Dashboard mounted devices such as those sold by Garmin and Magellan generally attain a higher degree of portability. However, they do not provide all the features of a PDA with a GPS add-on. In-car navigation systems developed for use with standard mobile phones, or for standard mobile phones with GPS add-ons, provide the closest competition for PDAs with GPS add-ons.

Yeoman's package offers in-car navigation on standard mobile phones in the UK (Dec 2001). Though it promises turn-by-turn navigation, GPS accuracy is missing, and it may be ineffective in practice. The Siemens GPS add-on for its phones may provide the necessary accuracy for turn-by-turn navigation, but may be difficult to operate. Driver distraction is an increasingly heated topic that will not go away.

PDAs with GPS add-ons are likely to become the most popular choice. Small, portable and powerful technology has always held great appeal. Combining PDA devices with the precision of GPS represents a natural progression. Users can plan their trip, customise maps and directions, and track their progress - at the office, on the move, or in the car.

Fleet Management and Tracking

This section is divided into five parts: an overview, applications, solutions, tracking and the conclusions.

Overview

What is happening in the B2B sector in Europe? Fleet management applications are finding success largely because trucking organizations have infrastructure that supports the telematics services. The same is not true of other vertical markets: contractors with specialized trucks, for instance, or estate agents that might appreciate constant on-board access to housing listings. While compelling at face value, the business cases based on these niches are not very attractive.

There has been a lot of interest in tracking activities recently. Though this has traditionally been an activity that has tended to be exploited more in the US, interest is now being generated in Europe. Several new companies are striving to satisfy the demand.

Applications

This section takes a look the location-based companies producing applications for fleet management.

List of companies

- Airbiquity
- Arbonaut
- Cellpoint
- MS Location
- PTV
- Radiolinja
- Siemens
- Webraska

Airbiquity

Airbiquity offers Automatic Vehicle Location and asset tracking. Its "aq" products are designed to help service fleets and transportation companies unify the technology that tracks their vehicles and other mobile assets. Airbiquity is partnering with several mobile product firms to provide technology operating over TDMA, CDMA, and GSM voice networks. It does not disclose who it is currently working with in this field.

Arbonaut

Arbonaut FleetManager enables companies to track their own vehicles online. Arbonaut markets this as a solution for both global and small-scale transportation companies. GSM terminals can be located by Web, WAP and SMS. Both GPS and network-based positioning technologies are supported.

Arbonaut is working with: Aplicom, Benefon, HP, IBM, Radiolinja and 3i.

Cellpoint

Cellpoint has signed up a few mobile operators for its fleet management application, Resource Manager. The following operators have signed up: Eurotel Praha (Oct 2000), Tele2 (Sep 2000), and France Telecom Mobiles (Jul 2000).

Its Resource Manager promises to enable transport, security, service and sales organisations to route their vehicles and mobile personnel more effectively. The last agreement signed for the implementation of Resource Manager was a year and a half ago.

MS Location

RoadTrack is an application which allows the tracking and location of moving objects: cars and trucks, individuals, valuable goods, and even animals. The real-time position of an unit can be viewed on a map or as an SMS message on any GSM phone. It supports various handset and terminal types: in-vehicle terminals, and GPS/GSM handsets. Object routes can be saved into a database to provide reports later on.

PTV

PTV is based in Germany and provides software, consulting and research for travel, traffic and transportation planning in the B2B field. Its fleet control systems are mainly employed for managing transportation means in the freight business. Trucks, containers or swap bodies with different stop-off points can all be tracked. Other lines of business such as courier, rescue or passenger services can also utilise the fleet control system.

The following components make up the fleet management system: on-board computer, communication server, satellite positioning, data exchange via mobile phone, internet and digital maps. The PTV fleet system solution is available for the headquarters of small, medium and large-sized fleets, and as a PC application or service via the internet.

PTV's operations are pan-European and it partners with many private companies in the following countries: Benelux, Germany, France, Italy, Austria, Poland, Switzerland, Slovakia and the Czech Republic.

Radiolinja

MS Location, in co-operation with Radiolinja, has tested an MS Location tracking application in connection with Nokia's network-based location technology in the Radiolinja network in Estonia (Mar 2001). There are plans to release a tracking application in the near future, and this is likely to be applied in a fleet management context.

Siemens

Siemens offers its m.traction Resource Control application for fleet tracking and supervision. It utilises existing handsets. Information such as the current location of all fleet vehicles and employees, the closest vehicle to a given location, or the route taken by a vehicle, can be displayed by a web browser anywhere in the world.

Since location information is captured from standard handsets, the need to purchase and maintain specialist devices such as satellite terminals is avoided. Workforce communication is facilitated by SMS or by WAP. In cases where higher accuracy is required, GPS terminals can be used.

Webraska

Webraska currently offers two applications for fleet management. IbDN Fleet is an internet-based fleet management solution, for commercial fleet managers, jointly developed and commercialized by Webraska and Sidewinder in the US. It enables real-time route optimization taking into account traffic congestion and is aimed at small fleet operators. The services are provided throughout Europe, North-America, Brazil and Australia.

IbDN Tracking is a web-based application which aggregates sequential position reports from IbDN-Lite clients and displays the routes on a web interface. IbDN Tracking is available as a "standalone" product, or can be integrated in customers' turnkey solution offering.

Solutions

This section takes a look at companies offering complete solutions for fleet management: packages generally including both hardware and software.

List of Companies

- Aplicom
- Benefon
- Novogroup
- Thales Navigation
- Trimble

Aplicom

Aplicom's roots extend to Nokia in Finland. It was a spin-off of the Mobile Data Unit of Nokia Mobile Phones. Aplicom products have been in existence since 1990, and Aplicom Oy was founded in 1995. It supplies both hardware and software.

Aplicom produces application independent on-board vehicle computers and related software for professional use in vehicles. They are marketed through partner network and automotive manufacturers. Aplicom has sold over 25 000 units in 18 countries and has around 100 system integrators and project partners worldwide. Over 95% of production is exported.

Aplicom Fleet is targeted at transport companies, courier, taxi and bus services - from small fleets to fleets of several hundred vehicles. The solution covers the most common needs of messaging, order dispatching, status messaging as well as advanced vehicle location functions.

Benefon

Benefon is marketing a resource management solution which it calls low-cost. The claimed cost-advantage is that not only fleet, but personnel such as servicemen, policemen, and couriers can be managed with the same application. The solution makes use of the Benefon Track, a GSM phone with GPS receiver and Mobile Phone Telematics Protocol (MPTP). The Benefon Track can be configured for several different purposes, for example, as a safety device, or as a mobile unit for resource management applications.

The recent agreement in February 2002 with CellPoint is evidence of the desire to create an advanced telematics solution utilising A-GPS, with a roadmap stretching all the way to 3G.

Novogroup

With a 30-year history in the business, Novo is focused on the Nordic markets. It also has foreign subsidiaries in six countries: in Estonia, Germany, China, the Netherlands, the UK and the US.

The Novogroup's fleet solution is independent of any particular network or positioning, and will integrate with new technologies as they arise. Its tracking and communication software integrates with existing IT environments, and is already used by the Defence Forces, police forces, for VIP tracking, security transport services, railways and the transportation sector in general.

Thales Navigation

Thales Navigation offers fleet management solutions to a variety of different sectors: emergency services, urban transport, transport of freight or currency, and open-cast mining machines. GPS is at the heart of its fleet management solutions. Thales Navigation has combined its expertise in GPS technology with its experience in data transmission for these applications.

Trimble

Trimble provides hardware, software and services for managing commercial fleets around the world on land, sea, or in the air. Trimble's experience in providing Automatic Vehicle Location solutions with messaging, mapping, and communications options solutions is utilised in the field of fleet management and mobile asset tracking.

Trimble is partnering with TRACKER Network in the UK (Jan 2002). Trimble's Global GPS technology is to be integrated with the next generation TRACKER Communicator, a vehicle management and telematics system to be made available in Europe

Tracking

This section considers companies with a specialised focus on tracking.

List of Companies

- Digital Angel
- Tracker
- Trackwell
- ULTRACOM

Digital Angel

US-based Digital Angel provides solutions for tracking people, pets and objects. The tracking devices make use of GPS.

Digital Angel claims to serve approximately one million pets in the US, and over 10 million in Europe with its patented microchips. There is also a Digital Angel AlertCall service which provides alerts if a person, animal or object strays beyond a specified point. Alerts can inform the user by mobile phone, PC, PDA or text pager.

Tracker

Based in Finland, Tracker has developed small radio tracking and telemetry devices since 1977. Tracker devices are sold in Belgium, England, Finland, France, Germany, Norway, Sweden, Switzerland and the US.

These devices can be applied in the following areas.

- Animal tracking devices - for hunting dogs, pets, falcon telemetry, domestic animals, research,
- Tracking of people - for patients, hikers, snow-mobilers, children
- Emergency beacon tracking (ELT) - tracking of Cospas-Sarsat satellite emergency transmitters (aircrafts, vessels, persons)
- Law-enforcement - for car theft detection systems, tracking of valuable property items
- Telemetry - for heart rate monitors
- Radio modules - for data transmission

Trackwell

Founded in Reykjavik, Iceland in 1996, TrackWell Software focuses on location-based applications that are based on tracking an object or a person. The product portfolio includes community-based services, entertainment services and information services. These are marketed at mobile operators and the professional market.

Its product portfolio includes:

- Personal tracking - Child tracker, Buddy Tracker, Location-based Date
- Professional tracking - TracScape, a platform for centralized fleet management
- Mobile Games - Mobile Warrior, SMS Games

Child Tracker is currently being offered to mobile operators and service providers (Feb 2002). The service enables parents to locate their children, and is based on the Buddy tracker engine. Buddy Tracker is provided by Iceland Telecom (Dec 2001).

Its partners are: Nokia, Ericsson and Hewlett Packard. Its customers are: Iceland Telecom, Radiolinja, and BT Cellnet.

ULTRACOM

Founded in 1993, ULTRACOM is a Finnish technology company specializing in RF electronics. Its products include: radio modules, radio modems, location radios, and UC antennas.

ULTRACOM has a specific application in mind for tracking. The ULTRAPPOINT Hunting Dog Locator helps locate hunting dogs by indicating the direction of the dog to the user. It consists of a separate receiver and a transmitter collar.

Conclusions

In the B2B sector, fleet management applications are finding success largely because trucking organizations have infrastructure that supports the telematics services. Location-based companies in the fleet management area can be divided into two groups: applications and solutions. Solutions generally include a package of software and hardware.

There is growing interest in the area of tracking in Europe. These services are categorised as Security ones. Tracking people, pets and objects are all possible with GPS. Digital Angel, Tracker, Trackwell and ULTRACOM all serve the European market. The rise in popularity of such services will depend on how successfully they are marketed. There are some clues as to how this might be achieved. Trackwell (Iceland), for example, classifies its applications according to the categories of: community-based, entertainment and information services. This creates a positive appeal by removing the focus on security.

Indoor Positioning

This section is divided into three parts: an overview, companies developing specific indoor positioning technologies and the conclusions.

Overview: The Need for New Technologies in the Indoor Environment

The issue of indoors tracking has been addressed by the Coordination Group on Access to Location Information by Emergency Services (CGALIES), whose charter is to explore options for implementing E112 emergency services in the European Union. The concern is that present technologies deployed for emergency services do not provide adequate coverage in some indoors environments.

Large steel and concrete buildings, subways and large shopping centres may be difficult or even impossible to cover using traditional wide area location technologies such as A-GPS (Assisted GPS), E-OTD (Enhanced Observed Time Difference of Arrival), and TDOA (Time Difference of Arrival). Low signal to noise ratio and signal multipath effects in these environments decrease tracking accuracy or even prevent signal acquisition. Neither do these technologies address three-dimensional positioning, which is required for pinpointing location in multi-story buildings.

A-GPS is likely to meet the requirements of most commercial assistance services for vehicles. However, in some urban settings A-GPS may not work at all. In contrast, E-OTD provides a high availability and accuracy in dense-urban areas and indoors. Combining the two technologies provides high accuracy and availability in all areas: outdoors, sub-urban, dense-urban and indoors. Nevertheless, this still leaves the question of three-dimensional positioning unresolved.

The nature of location-based applications offered in the indoor environments fundamentally differs. While 50 metres may be sufficient for most outdoor applications, such as traffic directions and restaurant searches, much better accuracy (1-3 metres) will be required by indoor applications. Such indoor navigation applications might be delivered at airports, conference centres and shopping centres. Emergency calls from high-rise buildings could make use of indoor positioning technology to specify the floor number. Other possible indoor applications include: the delivery of customized services and applications by enterprises to their employees, integrated access control systems that unlock doors based on the location of the user with an authorized device, and targeted advertising.

The market is in its infancy, but several new technologies are competing to provide such applications. The Pseudolite System is a navigation device positioned in areas that have poor reception to GPS signals, as well as for use with indoor locations. Other evolving technologies include WLAN, Bluetooth, Digital Television, RFID (radio frequency identification), infra-red, and ultrasonic positioning.

Indoor Positioning Technologies and the Companies Involved

This section describes the activities of companies developing specific indoor technologies.

List of Technologies and Organizations

- Bluetooth
 - Bluesoft
 - Bluetags
 - lesswire
- Digital television
 - Rosum
- Indoor GPS
 - Global Locate
 - NavIndoor
- Infra-red
 - Eyeled
- Radio Frequency Identification (RFID)
 - VTT
- Ultrasonic positioning
 - VTT
- WLAN positioning
 - Ekahau

Bluetooth

This section describes the activities of Bluesoft, Bluetags and lesswire in the field of Bluetooth positioning.

BlueTags

BlueTags is a Danish company founded in 1999. It specialises in the development of intelligent tags based on Bluetooth wireless technology. Its patented device is the BlueTag. The BlueTag can be used in various applications where there is a need for tracking, tracing, monitoring and identification of objects.

The BlueTag itself can be attached to or built into the object to be tracked. Hence, its physical shape can change according to the application. The device also acts as a communicative link between various handheld devices, such as mobile phones and PDAs with a Bluetooth network.

One advantage is that it is not necessary to wait for Bluetooth-equipped devices, such as mobile phones and PDAs. Existing handheld devices will work in combination with a BlueTag and Bluetooth network. This enables mobile phone operators and internet service providers to provide location based services using existing technologies such as e-mail, SMS, WAP, and I-mode.

Relevant applications include M-Commerce and Passenger Tracking. In M-Commerce, BlueTags could be used at shopping malls where customers equipped with a BlueTag would receive relevant location based sales information via mobile phone or PDA. In Passenger Tracking, the BlueTag could be used as a means to improve passenger processing in and around airports.

Bluesoft is one of its partners.

Bluesoft

Founded in 1999, Bluesoft develops positioning technologies and solutions for the short-range wireless connectivity market. Bluesoft's patent-pending distance measurement (DM) technology enables many Bluetooth wireless applications. Its location-finding technology aims to extend the capabilities of Bluetooth networks. The technology provides an accuracy of 2-4 metres, depending on the configuration of the network. It works well in dense urban environments.

Examples of applications that could make use of the ability to accurately locate Bluetooth devices include: indoor navigation, location-based gaming, targeted advertising, and security perimeter and usage control. Bluesoft's services are targeted at OEMs, wireless application developers, systems integrators and enterprises.

Bluesoft is partnering with Bluetags (for travel, industrial and consumer applications), and IBM (for queue management systems)(Feb 2002).

lesswire

lesswire offers products and solutions for wireless data transmission and information utilization on mobile devices in spatially defined areas. For example, trade fairs, museums, and manufacturing plants are all included in this area. Its products cover several diverse areas:

- Network components - for the development and sales of Bluetooth base stations
- Wireless solutions
- Wireless information provisioning
- Infrastructure - for location-based services (called LocalNavigator).

LocalNavigator is an integrated platform of software and hardware components that provides the infrastructure for mobile location services. This platform enables new services marketing models. Application development focuses on handheld devices such as PDAs, with hardware technology based on the Bluetooth standard. Its products work over any underlying network - GSM, GPRS, UMTS, or WLAN.

For the second consecutive year, lesswire and Deutsche Messe are providing the official electronic CeBIT exhibition guide for handhelds with Windows CE, Pocket PC, or Palm OS (Feb 2002).

Notable partners include Compaq and Siemens.

Digital Television

This section describes the activities of Rosum in the field of digital television positioning.

Rosum

US-based Rosum was founded in 2000. Rosum is developing a positioning technology that uses digital television (DTV) signals. The technology provides mobile users with meter-level accurate positioning indoors and in urban areas.

Rosum's solution uses DTV signals to determine location - each 6 MHz-wide signal is broadcast at powers up to one megawatt. High signal strength means the DTV positioning solution is able to offer superior coverage indoors and in urban areas. Unlike GPS signals that are transmitting at around twenty watts from over a thousand miles above the earth's surface, DTV can broadcast at megawatt levels at distances of a few tens of miles from the user. DTV's 6 MHz bandwidth is six times that of GPS.

In the last two years, the FCC has mandated that all television stations in the United States switch over from analog broadcasts to a digital standard. DTV location techniques can also be applied to digital television standards in Europe, Asia and Australia. DTV transmissions have characteristics that make them ideally suited for navigation and tracking applications.

Rosum uses a monitor unit that samples the available DTV broadcasts in an area and models the clock drift for each of the towers by measuring the drift against an atomic standard. The data generated by the monitor unit is sent to the Rosum position determining equipment and is used in the position calculations. For nationwide coverage, Rosum will need to build 200 of these monitor units throughout the US.

Rosum has completed an initial demonstration of its technology, and is partnering with KQED in San Francisco to conduct tests of the system in a variety of environments. Potential partners include: carriers, handset manufacturers and chipmakers. The claimed advantages of the system are:

- Minimal modification to existing cell networks
- Accurate positioning for a fraction of the cost of other methods
- Ability to track moving objects with quite minimal power and processing demands.
- Handset hardware will be inexpensive

Indoor GPS

This section describes the activities of Global Locate and the NAVIndoor research project in the field of Indoor GPS.

Global Locate

Global Locate was launched in 1999, with the aim of taking A-GPS technologies to the marketplace. Its corporate offices are in California, with a business development center in New Jersey and sales offices in the UK.

The IndoorGPS product offering can be broken down into two parts - the server and the chip set. On the server side, Global Locate has a Worldwide Reference Network, which tracks all the GPS satellites around the clock. This satellite data is then sent to Data Processing Hubs, where the satellite orbits and clock models are calculated for many days into the future. This data is provided to any number of A-GPS Servers on a worldwide basis, and stored for up to ten days.

It is claimed that for the IndoorGPS chip set:

- Average power consumption is a hundred times lower than for competing GPS chip sets
- Satellites fixes are acquired much faster (first fixes in 250 milliseconds)
- Sensitivity is much higher - works where GPS would not normally work

In practice, acquiring GPS signals indoors requires a combination of A-GPS and massive parallel correlation. The IndoorGPS receiver architecture performs massive parallel correlation entirely in its specialised hardware.

Fujitsu Microelectronics America and Global Locate are introducing a fast, low-power receiver that lets wireless phones receive GPS satellite signals indoors. The claimed major benefit is a time-to-first-fix of 250 milliseconds (Feb 2002). Other notable partners include SignalSoft (from April 2001), Benefon (from February 2001), and MS Location (from November 2000).

NAVIndoor

Started in November 2000, and ending in February 2002, NAVIndoor aims to develop a concept demonstration prototype of a system to enable accurate positioning and navigation in indoor and urban area environments. The system is GPS based.

Partners include: Space Systems Finland Oy, Fastrax Oy, and Positron Oy

Infra-red

This section describes the activities of Eyeled in the field of infra-red positioning.

Eyeled

Based in Germany, Eyeled implements mobile information solutions for Palm and Pocket PCs. The range includes digital company brochures, product catalogs, event guides, and functional descriptions. In addition, Eyeled also offers information and navigation systems which involve the transmission of information direct to mobile devices such as PDAs or Smart Phones with the help of infra-red, Bluetooth, GPRS, or WLAN techniques. Applications for these solutions include exhibitions, stations, administrative buildings, company premises, airports, hotels, department stores and museums as well as congresses, trade fairs and other events.

Applications on offer include the following:

- Info-point - provides information on departure and arrival times
- Flight schedules
- Tips on public events
- Up-to-date news at airports

The exhibition guide helps visitors navigate around fairs, whilst exhibitors make use of the system to provide information about themselves. An "electronic exhibition brochure" can be made available on PDAs for visitors to browse. The same system works in museums too. In hospitals, physicians can review patient data such as medication using the technology. Within large buildings, it can be used for guidance. In emergency situations, fire fighters could use it.

Radio Frequency Identification (RFID)

This section describes the activities of VTT in the field of RFID.

VTT

VTT is an organisation that carries out technical and techno economic research and development work in Finland. VTT currently researches RFID.

An RFID system utilises two pieces of hardware, a transponder (or tag) and a reader which communicate wirelessly. Current applications include electronic article surveillance, and animal identification. The main use for RFID is labeling. At the moment, there are no applications available for indoor location, though RFID is a technology that could potentially support them. Commercial opportunities in RFID for indoor location could, for example, include the labeling of items in museums.

RFID technology is expected to become commercial next year. Applications will probably follow, but it depends on the utilisation of the chip technology, and whether or not there is large-scale financial backing. One scenario involves the backing of a mobile phone manufacturer prepared to incorporate a chip enabling the reading of tags. Another consideration is price. If the price of the tags drop to 0.2 Euros each and they are small enough to be placed everywhere the forecast for widespread adoption is good.

Ultrasonic Positioning

This section describes the activities of VTT in the field of ultrasonic positioning.

VTT

In cooperation with Otatech, VTT is developing a method and device for determining position. The method is based on the measurement of ultrasonic pseudo random noise and its cross-correlation.

It is possible to implement an accurate positioning system based on this method, in a limited area, and - it is claimed - at low cost. The positioning method is best suited for indoor applications, for example, in industrial halls. The position of many moving objects can be calculated with an accuracy of 5 cm. The positioning system works in outdoor environments too, and could be modified to work at greater distances. Hence, one possible application would be the positioning of agricultural machines.

One useful feature is that there is no upper limit on the number of objects for positioning, and position information can be calculated 5 - 10 times per second. The device has been tested at industrial halls, as well as outdoors, with an accuracy of 1 - 5 cm.

WLAN Positioning

This section describes the activities of Ekahau in the field of WLAN positioning.

Ekahau

Founded in 2000, Ekahau is a young company, owned by employees and venture capital investors. Ekahau is based in Finland. The name Ekahau is derived from the god of travelers and merchants in Maya mythology. The underlying technology is being developed with the Complex Systems Computation Group at the University of Helsinki (CSCG). CSCG is one of the leading research groups in the world. Its core technology has been shaped by over ten years of study.

Ekahau claims to offer the first practical WLAN-based indoor positioning system that requires no proprietary hardware additions to the network. The technology features accuracy up to 2 metres and enables both people and asset tracking. Hence, the existing WLAN infrastructure is leveraged to provide precise location information.

In the future, Ekahau hopes to make use of the technology in a niche markets. The hospital environment is one such market - for the cost effective monitoring of patients and equipment. It could foreseeably be used on shop floors for customer tracking. The data could be used in the management of effective promotional campaigns.

Ekahau wants to concentrate on B2B applications in its chosen market. Hospitals are planning the use of indoor positioning for next year, but it will take a year to sell it to them and another one for them to take it into use. Overall, it will take 2-3 years for it to become operational in hospitals. Other commercial applications will take longer.

Logistics is another promising area. Several systems are already in existence and bigger warehouses will increase the need for employees to be directed to the appropriate shelves. In the same way that a taxi in Finland is directed to the closest customer, an employee who is closest to the right shelf can be directed there. By capitalising on existing WLAN and Voice-Over-IP, this can be an effective way of locating staff.

In the present business climate there are some major barriers. The lack of applications is one. It is normally the case that accurate co-ordinates are needed before investment in applications follows. The implementation costs are relatively low. Software for backroom servers is necessary to track items - this could cost between 10,000 and 20,000 dollars for the tracking of a 100 items, with the limit on items artificially set.

Conclusions

A-GPS (Assisted GPS), E-OTD (Enhanced Observed Time Difference of Arrival), and TDOA (Time Difference of Arrival) do not address the issue of highly accurate positioning for use indoors. Since these technologies do not address three-dimensional positioning either, in multi-story buildings they may provide grossly inaccurate positioning information. Large steel and concrete buildings, subways and large shopping centres also present coverage problems for the conventional technologies of A-GPS, E-OTD and TDOA.

Much better accuracy (1-3 metres) will be required by indoor applications. To fulfill this need new technologies are evolving rapidly. These include: WLAN, Bluetooth, Digital Television, RFID (radio frequency identification), indoor GPS, infra-red, and ultrasonic positioning. The newest of these techniques is Digital TV positioning, pioneered by US-based Rosum. This technique can also be applied to digital television standards in Europe. However, it is much too early to predict a technology winner in a market in its infancy.

European Research Activities

This section describes pan-European research activities in the area of positioning and location-based services. It is divided into four parts: positioning technology infrastructure, transport and tourism, and info-mobility, and the conclusions.

Positioning Technology Infrastructure

This section describes European-wide projects relating to the technology infrastructure for positioning. Projects that are part of the broader framework of the Information Society Technologies Programme are labeled IST.

List of Projects

- CELLO (IST)
- CGALIES
- EMILY (IST)
- GALILEO
- POS.IT (IST)
- GAUSS (IST)
- WINE GLASS (IST)

CELLO (IST)

The CELLO project (Cellular Network Optimisation based on Mobile Location) aims to utilise the mobile location information for various enhancements of the 2G/3G mobile networks. It was started in January 2001 and ends in August 2003.

In particular, a Mobile Network Geographic Information System (MGIS) is to be developed for collecting location-specific data from the cellular network and the mobile terminals. Based on the MGIS, it is hoped, a new network planning and optimisation concept will be developed. This could enable, for example, the observation of measurement-based coverage areas, location-specific handover performance data as well as variations in capacity demand. This information enables an Adaptive Coverage System (ACS), which will be implemented and tested in the project. In addition, the project also develops and validates location-aided handover algorithms and a mobility management function supporting multiple wireless systems including wireless LANs.

Participants include the following: the National Technical University of Athens, Teleplan, Elisa Communications, Motorola, and Cosmote.

CGALIES

CGALIES (Co-ordination Group on Access to Location Information by Emergency Services) was established in July 2000, as an initiative of the European Commission. The mission is to define requirements for a pan-European common location provisioning mechanism, that can be accessed and used by the European 112 community and emergency service operators.

Location information is of vital interest for emergency services throughout Europe, since accurate information about the exact position of an incident or accident could reduce response times for the emergency services. Quicker treatment of injuries could save the lives of European citizens since the automated provision of an accurate location would be very useful if a person is no longer able to speak.

The Final Report is now available (Jan 2002). However, the document is not intended to be a binding proposal on location information for emergency services. It is offered to the European Commission, to the European Union and its Member States, and citizens for broad consideration.

The main conclusions are as follows: an obligation for operators to deliver the best location information that is available within the network will in most cases deliver appreciable benefits for callers using both fixed and mobile networks. Major differences exist throughout the EC in the way networks process 112 calls. Hence, the aim should be to develop common standardised data formats and common standardised interfaces for the transfer of location information.

EMILY (IST)

The EMILY project (European Mobile Integrated Location System) is partially funded by European commission. It aims to facilitate the development of chipsets to perform the hybridization of GSM/GPRS/UMTS positioning (E-OTD) and GPS/GNSS positioning. It was started in January 2001 and ends in December 2002.

The first objective of the project is to assess and study all the implications to put in place a very efficient location service solution for the next generation of mobiles (GPRS). This includes technical, economical, regulatory (enhanced 112 emergency services), privacy and consumer protection and impact on UMTS standardisation. The second objective is to define the requirements of the location service system to comply with the major foreseen applications: roadside assistance services, location sensitive billing, concierge services, traffic and navigation services.

Companies involved include: Thales Navigation, T elit, MOGID, Bouygues Telecom, UPC, and ERTICO.

GALILEO

GALILEO aims to be the first system of navigation and positioning by satellite designed for civil purposes. The European Union and the European Space Agency will each provide funding of around EUR 40 million to begin with. A consortium of sixty-five companies is working on the project. It was started in 2000 and is expected to be completed in 2008.

There are currently two satellite navigation networks in the world, one American (GPS) and the other Russian (GLONASS). Both were designed with the military in mind and have drawbacks. There is, for example, no guarantee or liability cover provided by their operators. Hence, the need for GALILEO.

The GALILEO project intends to enable each individual, by way of a small, cheap individual receiver, to know his or her position to within a few metres. With the support of the European Space Agency, the aim is to launch a series of satellites. These will be placed in orbit at around 20 000 km and monitored by a network of ground control stations in order to provide reliable world cover.

GALILEO intends to provide the precision needed for these applications (5 to 10 m) and offer the guarantees and liability cover that are currently missing. Three levels of service are envisaged:

- Basic, free of charge services - for applications intended for the public at large
- Subscription service with restricted access - for commercial and professional applications
- High-level subscription service with very restricted access - for applications which must not suffer any interruption or disturbance for reasons of security

The cost of developing GALILEO and bringing it into operation has been estimated at around EUR 3 billion. It is clear private investment will also be needed.

GAUSS (IST)

The GAUSS (Galileo And UMTS Synergetic System) project intends to demonstrate the possible integration between navigation and communication services. This will take place within the framework of the new technologies which are being developed for the S-UMTS (Satellite Universal Mobile Telecommunication System) and for GALILEO. It was started in December 2000.

Applications are to be developed for the Intelligent Transport Infrastructure and Mobility Management field. This relates specifically to the development of on-board systems aiming at improving the comfort, and the more efficient use of intelligent vehicles for all modes of transport. In the field of personal health, GAUSS intends to develop an advanced tele-medicine application supporting health-service management. GAUSS is also concerned with improving the mobility of people who have difficulties in traveling around for work, education and recreation.

Partners involved in the project include: Thales Navigation, Telefonica, Telespazio, and Ericsson.

POS.IT (IST)

The POS.IT Consortium is formed by Ibermatica, Amena, Seur and Ericsson. It aims to trial services accessed by WAP, enabled by cell positioning and communication capabilities in GSM and GPRS cellular networks. It was started in November 2000 and ended in August 2001.

The trial consists of an application that integrates several services provided by terrestrial cellular networks. One of the services is for fleet management, which includes a mobile positioning system to help courier companies locate their vehicles and personnel and distribute new tasks more effectively. Other services provide delivery control to help plan and manage the assignment of delivery tasks, and electronic payment to allow clients to pay for deliveries over mobile phone.

The trial application is aimed at the transportation sector, and sales and service organizations needing a more efficient way of planning the distribution of resources. This involves locating the position of a vehicle via mobile phone, then monitoring and displaying the vehicle on a map.

WINE GLASS (IST)

The WINE GLASS project aims to support technical innovation by exploiting the potential of IP-based wireless mobile multimedia networking with UMTS and WLANs. This also involves exploring their potential in enabling location-aware and QoS-aware application services for wireless mobile users.

It is hoped that upon completion, the project will have developed a wireless Internet test bed incorporating:

- IP backbone
- UTRAN access to IP-based core network
- WLAN access to intranets - to test and evaluate such techniques and applications

Transport and Tourism

This section describes projects which come under the heading of Transport and Tourism. These projects are part of the broader framework of the Information Society Technologies Programme (IST).

List of Projects

- GUIDEFREE
- INVETE
- PALIO
- TELLMARIS
- TPEG
- WHAM

GUIDEFREE

GUIDEFREE aims to use telematics to enable more freedom for tourists at special sites. It was started in October 2000 and ends in March 2002.

GUIDEFREE seeks to bring customised site information to the independent tourist traveler, particularly focusing on visits of tourist sites. The idea is that the user should be able to access the information about tourist sites prior to or during a trip, at any geographical location.

During the course of the project the following will be developed:

- Data integration disciplines
- Data transformation schemes
- Methods for guiding users in the use of the integrated data
- Customised data mining methods

Mobile-access and fixed-access methods for new personalised services The project is to assess its product at four sites, two in Greece, one in Italy, and one in Austria.

Participants include: Systema Informatics (Greece), the Pori School of Technology and Economics (Finland), and Porin Puhelin (Finland).

INVETE

INVETE (Intelligent in-vehicle terminal for multi-modal flexible collective transport services) aims to develop a modular intelligent in-vehicle terminal (IVT) for different transport services. The project is hosted by the Technical Research Centre of Finland (VTT). It was started in January 2000 and ends in March 2002.

IVT, a multi-application device, responds to the user needs of the driver and the operational requirements of transport services, such as those provided by bus and taxi companies. Through the integration of on-board communication and location devices with the control centre, the IVT aims at improving the quality and reliability of the transport services provided to citizens. In addition, the IVT is designed to operate in different communications environments such as GSM and private radio network (PRN). The INVETE terminal is to be demonstrated in environments with high-technology infrastructure in Finland and Italy.

Participants include: ENEA (Italy), Softeco Sismat (Italy), Transport Infrastructure & Telematics (Belgium), Vlaamse Vervoermaatschappij (Belgium), Koiviston Auto (Finland) Instrumentointi (Finland), ATAF (Italy), Memex (Italy) and Mobisoft (Finland).

PALIO

The PALIO (Personalised Access to Local Information and services for tourists) project is part-funded by the European commission IST fifth framework Programme. It was started in November 2000 and ends in April 2003.

Though tourism is one of the major European economical, cultural and social enterprises, information and support services for tourists are often inadequate. Information about sites of interest to tourist is often not easily available. As a result, tourists may get lost when moving from one site of interest to another in the same city, or not have enough information to decide among different options. Hence, the high-level objective of the project is to demonstrate the feasibility of providing tourist information in such contexts of use.

Partners include: the Hellenic Telecommunications and Telematics application company, Foundation Research & Technology (Hellas), and Telecom Italia Mobile

TELLMARIS

TELLMARIS aims at the development of a 3D-map interface for tourist information on mobile computers. It was started in June 2001 and ends in December 2003,

TellMaris focuses on tourists and citizens on the move, and their need for personalised tourism information using mobile. The main scientific objective is to develop new data structures for representing interactive 3D maps on mobile terminals, combined with mobile location services. The project utilises the integration of recent technological and scientific advances within telecommunications, geometric modeling, geospatial technology and computer graphics in an effort to provide better means for information retrieval on mobile terminals.

It is expected that the project will produce a 3D map interface for the Tellus Destination Management System. It is hoped the system will be sold to the major harbours in the Baltic Sea Region. In addition, it is hoped it will commercialise other products based on terrain models, promote m-commerce related technology, and increase the knowledge of 3D city models for future RTD projects.

Participants include: Nokia, Tellus, the St. Petersburg City Tourist Information Center, Finnish University of Technology (Finland), and the City of Turku (Finland).

TPEG

TPEG aims at being a new broadcast technology designed to deliver Traffic and Travel Information (TTI) for Europeans.

The new TTI multimedia service based on TPEG will become available at different times, depending on the broadcast medium. For the internet this means from 2000, for mobile internet from 2001, for Digital Radio from 2003, and for Interactive TV from 2004. Hence, TPEG applications can utilise the Internet today, but Digital Radio will take a few years to give pan-European coverage.

TPEG applications allow the end-user to filter the information received according to personalised requirements. Information may take into account journey needs and the transport modes chosen. At present, a TPEG-Road Traffic Message application is supported by the TPEG-Service and Network Information application to allow access to TTI from a variety of sources. More applications are planned.

Test areas include Germany (Munich, Stuttgart and other parts of south-west Germany), Sweden (Stockholm and large parts of the country), and the UK (London and large parts of the country).

Participants include the following: Clarion, Grundig, Panasonic European Laboratories, Pioneer Technology, Sony International Europe, VDO Car Communication and Renault.

WHAM

The WHAM (he World In Your Hands On The Move) project aims to fulfill the need for on-the-move, real time, location-dependent, customised tourism and travel information. It was started in December 2000 and ends in November 2002.

In practical terms, this means the development of a suite of software modules and services to collect information about tourism, weather, and maps and deliver it in customised format via mobile devices to the end-user. Operationally, the project's objectives are to be achieved by means of three different prototypes of the system to be validated in three different Member States:

- City information and service centre based in Madrid
- Regional multi-modal tourist information service in Greece
- Information and service centre serving Levi, a major tourism resort in Lapland, Finland

The partners include: the Port of Piraeus Authority (Greece), Athens University of Economics and Business, Turmadrid (Spain), Hellenic Civil Aviation Authority (Greece), Levin Matkailu (Finland), Tampereen Viatek (Finland), Consorcio Regional de Transportes de Madrid (Spain), and the Association of Greek Tourist Enterprises (Greece).

Info-Mobility

This section describes projects that fall under the heading Info-Mobility and are part of the broader framework of the Information Society Technologies Programme (IST). In addition, they represent Cross Program Actions (CPAs) designed to enhance the integration of knowledge from different areas.

List of Projects

- GiMoDig
- IMAGE

GiMoDig

GiMoDig (Geospatial info-mobility service by real-time data-integration and generalisation) aims to develop methods for real-time integration and generalisation of national topographic databases so as to make them accessible for mobile users via a unified service across Europe. The project is hosted by the Finnish Geodetic Institute. It was started in November 2001 and ends in October 2004.

Due to closed system architectures, national geospatial databases in Europe are often inaccessible for mobile use. This is largely because of differing spatial reference systems and heterogeneous data models. Hence, the objective of the project is to develop methods for delivering geospatial data to a mobile user by means of real-time data-integration and generalisation. The project hopes to identify essential user needs for different contexts in the mobile use of map data - a key issue is how to display cartographic visualisations on mobile devices with small displays.

Participants include: the University of Hannover (Germany), Bundesamt fuer Kartographie und Geodaesie (Germany), the National Land Survey of Finland, the National Land Survey of Sweden, and the National Survey and Cadastre (Denmark).

IMAGE

IMAGE (Intelligent Mobility Agent for Complex Geographic Environments) aims to provide mobile users with personalised, location based information on services, how to reach them and how to pay for them. It was started in November 2001 and ends in October 2003.

To meet its aim, IMAGE intends to develop an open and modular service platform, which co-ordinates end user data and service provider data. This involves developing key services for navigation, location-based applications, and e-commerce services as an integrated package. The needs of different groups - the drivers (e.g. taxis, minibuses), the operators (e.g. public transport companies and taxi associations), the control centres (e.g. travel dispatch centres), the authorities and different transport services - are to be identified and classified accordingly.

Participants include: Ministry Transport and Communications (Finland), 3C Systems (Finland), Mobisoft (Finland), Personal Media Systems (Finland), Tampere City Transport (Finland), Unicom Consulting (Finland), Centre for Research and Technology Hellas / Hellenic Institute of Transport (Greece), Transeuropean Consulting Unit of Thessaloniki (Greece), Singular International (Greece), INTRASOFT (Greece), 5T (Italy), Centro Studi sui Sistemi di Trasporto (Italy), Mizar Mediaservice (Italy), Transport Operations Research Group, University of Newcastle Upon Tyne (UK), and PTV (Germany).

Conclusions

There are a number of projects relating to the positioning technology infrastructure in Europe. In particular, two projects warrant more attention than the others in this area - CGALIES and GALILEO. CGALIES is defining requirements for a pan-European common location provisioning mechanism that can be accessed and used by the European 112 community. The final report is available now (Jan 2002), and is not intended to be a binding proposal. There is no government mandate for emergency services as there is in the US. Hence, the focus of location-based services in Europe can remain commercial.

The GALILEO project is another pan-European project based on GPS technology. It intends to enable each European citizen to know his or her position to within a few metres. With the support of the European Space Agency it aims at launching a series of satellites. There will be three levels of service: basic, subscription, and high-level subscription.

Transport and tourism is also a focus of attention at the European level. Tourism is one of the major European economical, cultural and social enterprises. However, information and support services for tourists are often inadequate. Several projects are operating to fill the vacuum:

- GUIDEFREE - seeks to provide customised site information
- INVETE - seeks to develop an in-vehicle terminal (IVT)
- PALIO - aims to provide personalised access to local information
- TELLMARIS - aims at the development of a 3D-map interface
- TPEG - aims at providing travel information using new broadcast technologies
- WHAM - seeks to provide customised tourism and travel information

In the area of info-mobility there are two ongoing projects:

- GiMoDig - aims at being a geospatial info-mobility service
- IMAGE - aims to provide mobile users with personalised, location based information on services

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