

# UBI ES?

**NAVIFUTURE**

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FUTURES REPORT ON  
PERSONAL NAVIGATION





(WHERE ARE YOU?)

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# PREFACE

The purpose of the NAVIfuture Project is to produce an expert assessment of the development by 2005 of the personal navigation market. The definition of personal navigation used in this survey is a broad one, covering positioning technology and its utilisation, especially using mobile devices, both in consumer and professional applications and services. The project also aims to support the strategy processes of the parties of the NAVI network.

The project uses the so-called Delphi method, in which experts reply anonymously to a comprehensive questionnaire and present grounds for their replies. Experts in the NAVIfuture Project replied to the questionnaire following their individual schedules within a specified deadline. As each round was completed, the panellists were given an opportunity to see all the replies and their grounds anonymously on the Net.

Three Delphi rounds were involved in the NAVIfuture Project. The purpose of using more than one round is to allow the experts' ideas and knowledge an opportunity to develop over time, and to bring out more clearly the grounds of the responses through the shared process of learning. The purpose of the first round was to produce information about the key driving forces and trends in this field. The second round was used to develop and deepen the common understanding regarding the forces and trends by critically examining the results of the first round. The third round was geared to identify the "hot" and strategically important issues concerning the technological development of the field, its applications and services and the continually diversifying culture of use that had emerged during the first two rounds.

Reporting was based on the simple principle that the material speaks for itself. We have deliberately kept our own assessments and those of other sources to a minimum to ensure that the voice of our material is not lost in a mass of external perspectives.

While, in the case of many issues, we have sought to employ clear-cut definitions of future technologies, applications, services, markets and cultures of use, we have also, in many other cases, provided an opportunity to give grounds for the experts' views, to highlight the range of possible viewpoints with qualitative material.

This report, therefore, seeks to present a compact version of the prevailing views of the experts, while also presenting the differences between the responses. The first two questionnaires received responses from 68% of the

experts enrolled in the survey. In the third round, the response rate fell to 51%. Organisations that participated in the survey are listed in Appendix.

This report is published in English and Finnish. The project was managed by Dr. Markku Wilenius and coordinators Pauli Saloranta and Marja Innanen from the Finland Futures Research Centre of the Turku School of Economics and Business Administration. The report was written by Dr. Wilenius. The report makes use of background material produced by Mr. Antti Rainio with regard to technology and applications, and by Dr. Mika Pantzar and Ms. Minna Tarkka with regard to user culture. Tomi Snellman did a great job in English translation. We especially wish to thank NAVI coordinator Antti Rainio for his excellent cooperation. Above all, we wish to thank the experts in the NAVI network who took the trouble to answer our questionnaire in the midst of their other engagements.

# 1 INTRODUCTION

The future is a process of unfolding and therefore always dynamic, in a state of flux. Because the present always incorporates some part of the future, we are able, now and with the means we have at our disposal, to try to identify the issues and factors that are crucial for the formation of the future. From the perspective of developing national competitiveness and corporate operations, future visions and foresight must be integrated with procedures with which we systematically develop our own competencies. Without foresight there can be no well-argued vision of how we should target our finite resources<sup>1</sup>.

The German philosopher Immanuel Kant observed that man understands reality primarily through two dimensions: time and place. Without knowledge and a conception of where in space one happens to be at a specific point in time, one easily feels “out of place” and is, therefore, “lost”. As we talk about the development of personal navigation, we are, therefore, dealing with basic human needs.

The advances of mobile technology have revolutionised communication, making it relatively independent of time and place. Mobile technology increases the efficiency of business operations as information moves at ever faster rates between individuals and companies. For an ordinary person, the mobile phone is above all a tool for coping with everyday life and social relations<sup>2</sup>. The mobile phone brings us into an ever closer contact with our social network.

Positioning has, for some time now, been often considered the next “revolution” in mobile technology. As this report shows, conviction that the breakthrough will eventually happen still abounds. However, in winter 2002–03, it seems that the utilisation of positioning is increasing at a much slower rate than anticipated. Location technology and associated applications have only recently achieved the level of reliability that allows operators the courage to begin selling services. Many of the services are still in the testing stage.

The bursting of the IT bubble has naturally contributed to the fact that experts are now emphasising aspects such as utility and need. Or as Prof. Petri

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1 See Mika Aaltonen & Markku Wilenius (2002): Osaamisen ennakointi. Helsinki: Edita

2 For more information, see Timo Kopomaa (2000): The City in Your Pocket. Birth of the Mobile Information Society. Helsinki: Gaudeamus



Mähönen observed in the interim seminar of the project, we have returned to technological realism. However, this may lead to an unintended neglect of the potential of users' own abilities to participate in the creation of needs and discovering new modes of use.

The "taming" of technology, to use Mika Pantzar's metaphor, is in itself already a complex process, the result of which cannot be reliably foretold<sup>3</sup>. The question is not whether positioning technology satisfies some "genuine" user needs. We should instead ask, can navigation technology help us to alter the everyday life of our employees and ordinary consumers in some desired direction? Take SMS, for example. It did not become a huge success because of the identification of some genuine need of consumers to use text messages to communicate. SMS became a breakthrough above all because consumers discovered a use for it, one that enriches their life.

In her doctoral dissertation, Marja-Liisa Viherä has observed that there are three perspectives or criteria which can be fruitfully applied to examining the use of different media in interpersonal communication: first, the motivation of people to use communication devices, second, the way in which they use the devices, and third, their access to the devices. All three criteria must be satisfied before use can become ubiquitous.

For example, we can use this scheme to analyse why vehicle navigation devices have such poor penetration on the Finnish market. Finnish drivers, professional and private, would undoubtedly be motivated to adopt a car navigation system, even though traffic jams are not as common or road networks as complex as in continental Europe, for instance. A navigation system could help taxis find their way to an unknown address, and people from out of town would not need to pore over a map to find an unfamiliar place.

We can also consider the fact that current car navigation systems are fairly simple and straightforward to use compared to computer programmes, for example. As the success of the technology in Western Europe shows, users seldom find it difficult to begin using car navigation devices. The greatest obstacle explaining the low penetration in Finland is, in fact, a problem of "access": until very recently, there have been no CD road maps available that would have been usable in navigation devices. Now that such maps have been available since last summer, we may ask, is the satisfaction of this criterion enough to make car navigation more popular in Finland as well.

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3 Mika Pantzar (1997). *How to Tame Technology*. [Kuinka teknologia kesytetään.] Helsinki: Hanki ja Jää.

This report focuses on assessing the future development of the market for personal navigation and location services, based on expert views. Although the survey did not involve scenario work as such, the views of the panellists were asked and processed in the characteristic spirit of futures research, where the future is seen as an open system that can become reality in several alternative ways.

On the other hand, we must remember that views are always formed in a specific historical situation. The responses could certainly have been more optimistic and “visionary” if the Delphi rounds had taken place before the bursting of the IT bubble. Now the assessments were throughout very “realistic” and cautious, even too cautious, according to some views expressed in the interim seminar.

However, much will happen before we shall land on the target year of this exercise, 2005. This year was deliberately chosen as one that is far enough from present, without being too distant in horizon. In the following pages, the experts of NAVI network will share their vision about world of personal navigation in 2005.

**TYPICAL motives for the adoption of a new technology: savings in costs, easy transmission of information, and enhancement of general security.**

**THERE ARE no “correct” or “genuine” needs, only different modes of use.**

## **2 BUSINESS**

### **2.1 MARKETS**

The market for location-based services (LBS) is diversifying. History shows that in the general evolution of markets, public services develop first, and then the services are gradually adopted for different professions and leisure activities. Typical motives for the adoption of a new technology have included at least savings in costs, easy transmission of information, and enhancement of general security. The general mood of economic recession in recent years has led to an emphasis on aspects such as need and utility in particular.

Markets are made up of producers and consumers. The production value chain consists of several actors: device manufacturers, application developers, telecommunication operators and portals, network suppliers and producers of map information. Mobile phone operators are important actors, especially in the case of mass applications. On the other hand, content producers providing generic services are also an essential part of the value chain. The concept of network services is in competition with downloadable applications and other alternative methods for information acquisition.

We must remember that designers do not have a monopoly on what use the products are put to. As consumers, users participate in the creation of their own needs and may come up with novel and unforeseeable uses for services and applications. There are no “correct” or “genuine” needs, only different modes of use, which help employees do their jobs better or enrich the everyday life of ordinary consumers.

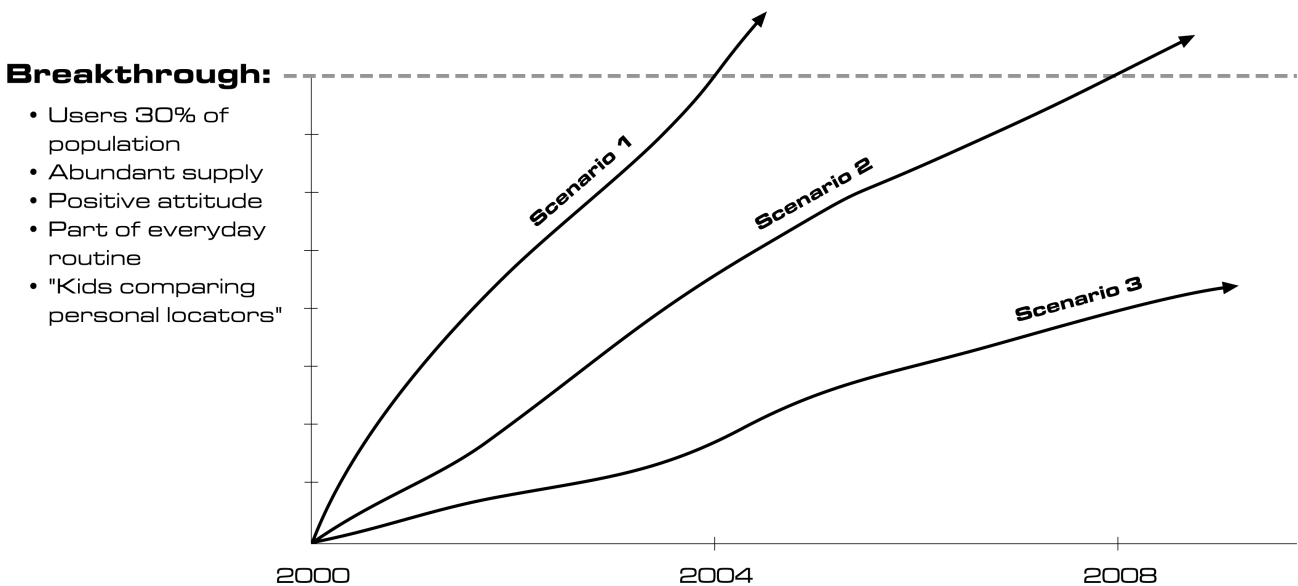
#### **2.1.1 The Breakthrough of Mobile Positioning**

In the assessment of market development it became apparent that, after the bursting of the IT bubble, we have entered an era when experts are clearly cautious regarding estimates where markets may develop in the future, or when the global breakthrough of positioning technology will really take place. We may say that the breakthrough is contingent on at least two things related to product development: First, there must be finished products and services that can be taken into use immediately. Second, there must be a significant number of consumers who begin using the products. With respect to market dynamics, the crucial question most likely is: How can the passion of a few

dozen professionals and enthusiasts be transformed into the routine of a large user base?

Asked to pinpoint the breakthrough of mobile positioning, the responses fell clearly into two categories: either in the near future in 2004, or at a later date in 2008 (or even later than that). The criteria for a breakthrough cited by the experts included sufficient penetration (10-30% of the total mobile market), a sufficiently large supply of applications and services, and a change in the attitude climate in favour of positioning. According to many respondents, a breakthrough is reality only when the thing has become part of everyday life and no longer attracts any special attention. Another response was that the breakthrough is a reality when positioning has become a natural part of the logic of the service, that is, part of "normal mobile operations" and when people have been instilled with, or have acquired the need for, positioning. The real breakthrough in mass markets is a reality when "kids in the yard compare their personal locators".

Figure 1. The Breakthrough of Mobile Positioning. Three scenarios.



The breakthrough becomes possible when there is a sufficient supply of suitable devices, the equipment base is sufficiently diverse, and the price has come down. The breakthrough can also be facilitated by the spreading of the feeling that the value added of positioning is worth the expense. The potential in 2005 will be greatest among professional users. Consumer applications will certainly undergo a breakthrough in the future providing entertainment and assistance in everyday life.

**THE BREAK-THROUGH needs clear business models.**

**MOBILE LBS market in 2005 will be most advanced in Japan, next in Europe, and third in the USA.**

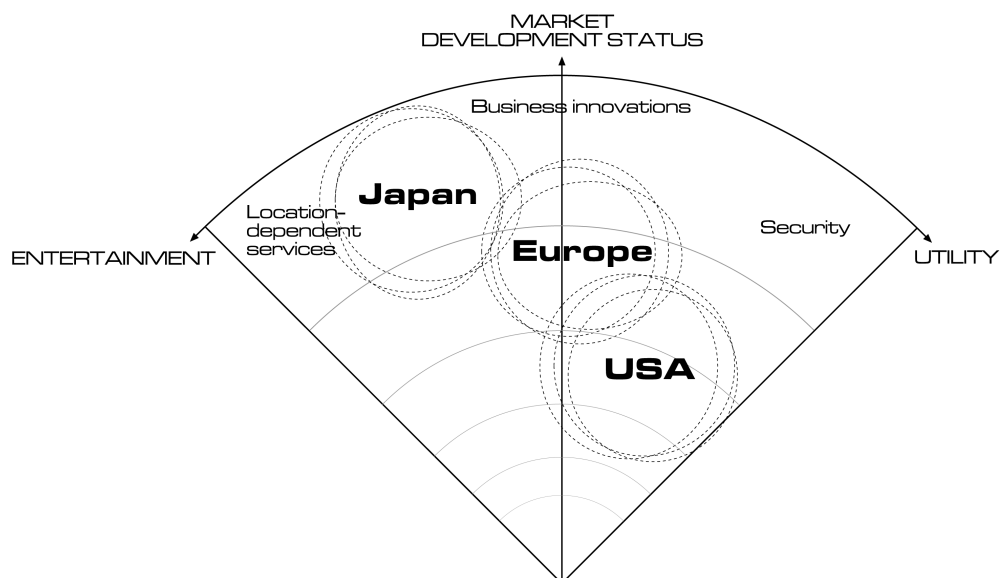
**THE JAPANESE market is fluid, where the tiniest drop spreads rapidly through imitation.**

From the perspective of developing corporate operations, the issue should be quite clear: The breakthrough of mobile positioning will take place when the supply of positioning technology to the market is a clearly profitable business proposition. This in turn calls for a sufficiently large user base and, above all, functioning services that entice consumers to put the new technology to diverse uses.

### 2.1.2 The Market and Its Development in Japan, the USA and Europe

We asked the experts to assess the development of the mobile market in Japan, the USA and Europe. How do they perceive the development within these areas and the competition between them by 2005? The prevailing view of the experts is succinctly illustrated by the comment of one respondent, who said: "The Japanese market is and will be the most advanced in the near future." According to most respondents, the mobile LBS market in 2005 will be most advanced in Japan, next in Europe, and third in the USA.

*Figure 2. The Development of Markets on Different Continents and Countries.*



The markets are also very different around the world. In Japan, positioning applications were expected to be mainly commercial game and entertainment applications. Moreover, services in Japan will be predominantly "pedestrian" services, and location-dependent services. The Japanese market is fluid, where the tiniest drop spreads rapidly through imitation. The emergence of a large

market in Japan is facilitated by a large population, as well as an up-to-date, high-quality equipment base. On the other hand, needs, too, can be greater in Japan, owing to factors such as the confusing address system.

The 2005 mobile market in the USA was expected to be “state driven” because of the law on emergency call positioning. In the US market, security services and vehicle navigation will be the most sought-after services. Mobile devices will be mainly of the PDA type. The market is expected to be homogeneous, but the standards fragmented. A special weakness of the USA will be the, in relative terms, very slow development of the mobile market and, above all, the lack of roaming in services (such as SMS). On the other hand, the USA is currently constructing a positioning infrastructure, and we can expect that it will also be utilised commercially.

In Europe, the future of mobile navigation applications was seen mostly as one of sensible (business) applications, not so much entertainment. Development was expected to be slow, as it is hampered by many socio-cultural differences. In spite of advanced standards, the development of the positioning market will be quite seriously obstructed by the fact that Europe is culturally very heterogeneous. As mobile LBSs will be predominantly content services and, thus, language specific, development will be slowed down by regionally differing practices.

European users were expected to be primarily professionals. Because the European markets are small, Europe will also have to invest in international services, unlike Japan and the US, whose domestic markets will be sufficient for them.

How can we then expect Europe to survive in the global positioning market? The current situation is not good: UMTS deals have made a major dent in the resources of many European operators, and the whole process has had a paralysing effect in more ways than one. As a result, venture capitalists are still too cautious, and the risk that Europe will remain at the tail end of global development is considerable.

According to many respondents, competitiveness can only improve in the future if the mobile technology infrastructure develops in a direction that enables positioning on a broad basis. Of course, this alone will not be enough. What is also needed is advanced services consumers perceive as “indispensable”, easy to use and inexpensive. Moreover, it was estimated that, as the demographic structure of Europe will change radically over the next ten years or so, safety-enhancing services may prove to be considerably more popular than at present. According to some respondents, the success of Europe depends on the creation of sufficient interoperability to improve the functioning of the

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**VERTICAL solutions will bring value added to users in some specialist fields, whereas horizontal solutions can easily remain too undifferentiated.**

fragmented consumer market. Another point that was made in this connection was that Europe has a long tradition of consumer-oriented services and that Europe could, in the future, be a pioneer in this field compared to the US.

The European Galileo satellite positioning system was expected to have a positive impact on European markets, as the system’s implementation will generate interest in positioning and its utilisation. On the other hand, some of the experts did not think that the Galileo project would make any difference on the European market: “It only creates hype around the technology.” The greatest impact of Galileo was expected to be in the development of professional and public service applications. Regardless of the American GPS system, Galileo was regarded as a positive development.

The future competitive status of Europe was generally regarded as fairly good, even though Japan’s lead and the emergence of other Asian countries will make competition tougher. This will call for solid investment from European actors and perhaps also more perceptive monitoring of what is taking place elsewhere in the world.

### 2.1.3 Horizontal vs. Vertical Markets

The development of the mobile market has shown that in emerging markets comprehensive “full-service turnkey solutions” often gain ground at first. For example, in many countries users automatically receive a handset when they purchase a mobile phone subscription. As the market evolves, more and more service layers appear, allowing users to choose between service providers, as well as mobile devices. In practice, there can be great differences in the value added services of operators, such as in the provision of positioning services, which leads to a blending of the horizontal layers of the market.

The horizontal and vertical development of markets was addressed in two questions. Horizontal competition was expected in telecommunications connections, devices, map services and navigation services. The technological and commercial maturity of components and their respective standards will probably affect the amount of competition. The more mature the component, the more likely it is to face competition. As the services become more widespread, so their comparability also increases. “Competition will not take place in network-based positioning, because the service is provided only by the operator,” said one of the experts.

The market status of dedicated (“turnkey”) vertical solutions designed for a specific branch, task or environment, was evaluated as fairly important. One reason for this is that people will not know what value added are on

offer. In that situation, it is easier to buy a package than to assemble the services from different sources. The device itself may be chosen freely, but the services will be packaged. Vertical solutions will bring value added to users in some specialist fields, whereas horizontal solutions can easily remain too undifferentiated.

## **2.2 THE VALUE CHAIN AND THE CHALLENGES OF EARNING LOGIC**

The value chain of positioning service provision may be quite long, which can easily make the earning logic quite complex. Customers can either purchase a product, use it as a mobile service, or download its content over the Internet. As the rate of the development of terminals and data transmission services is quite high and continuous, earning models have not had a chance to become established.

A positioning service can be paid for by the user, or the concept may be based on third-party funding. Billing in the future can be based on the duration of the event, the quality of the service, or be a flat monthly sum irrespective of the duration of use. All these billing types are currently in use. The drawback of the flat monthly fee may be a higher adoption threshold, although it may have the benefit that the user becomes used to the service faster.

In long value chains, achieving a satisfactory distribution of income is always a challenge. Whereas in small markets, a 50/50 distribution can apply between the operator and the content producer, in large markets, such as Japan, the operator may have to make do with a smaller proportion, while charging for the data transmission. It is only natural that, in offering network-based positioning services, the operator wants to get a payment in some way or another.

The cost of a positioning service can be divided among more than one actor. If the service is paid for by the employer, this may affect the behaviour of the consumers. In marketing and advertising related services, the service can also be paid for by some other party, such as an oil company paying the price of transmitting to a potential customer information about the company's nearest gas station. A LBS can also be sold as an add-on: for instance, the consumer can permit direct marketing and receive in return a weather forecast service for the location where they happen to be. A LBS can also be part of a larger package, such as a tour organiser who offers a route guidance service for their customers during the trip.

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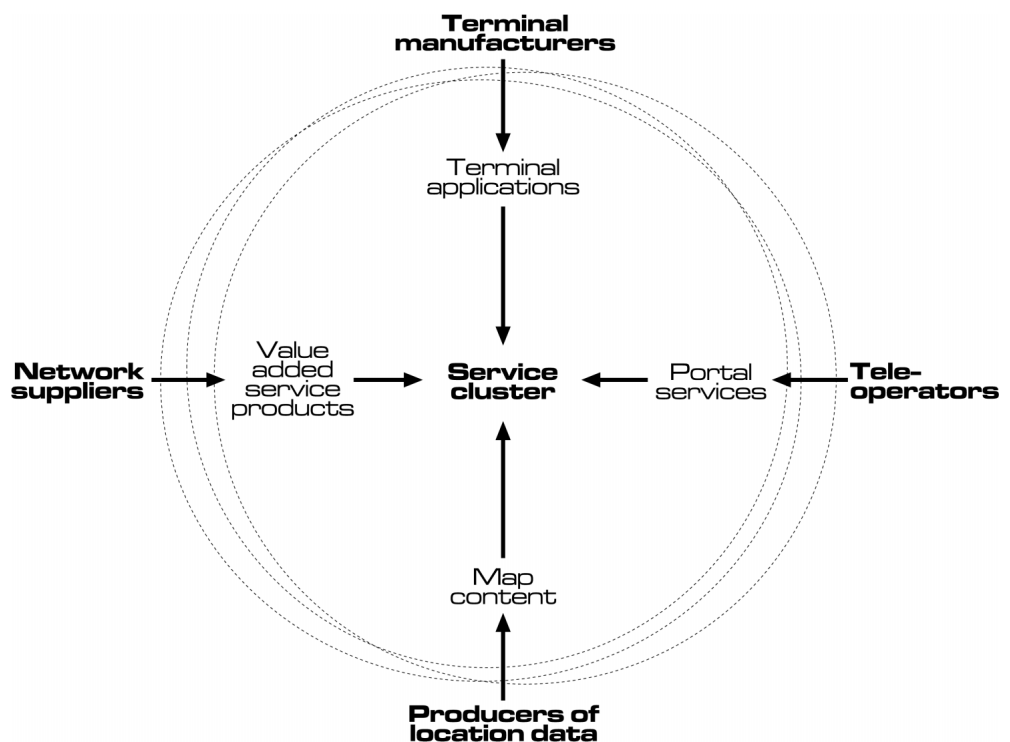


**NEW cooperation service clusters have emerged that utilise and develop positioning services to provide value added to their customers.**

**POTENTIAL applications in the future are services where users produce the content themselves.**

As we can see, the positioning value chain contains many components. New cooperation service clusters have emerged that utilise and develop positioning services to provide value added to their customers. Terminal manufacturers cooperate with application developers. Teleoperators have gathered positioning-related services into their portals. Network operators have sought cooperation with providers of value added services in particular to develop the marketing of network-based positioning products. Producers of map data are interested in potential new channels for distributing their products.

Figure 3. The Value Chain of Positioning



Cooperation in the device sector is generally built around GSM phones or other independent positioning applications that are able to broadcast their location to the service centre or directly to other users. Typical partners have been companies using security services and developers of software and service centre applications. Typical customers are transportation companies. Potential applications in the future are services where users produce the content themselves, such as birders. Other potential services for the consumer market include community applications that provide geographic data on members of the community.

Teleoperators have until now provided consumers with weather and news services, map and route services, different directory services and location-based marketing solutions, either proprietary or produced with partners. Dating services and mobile games have also been under development. Services targeted to a more professional clientele have included the monitoring of transportation and mobile work. Zone billing is an obvious choice in markets where there is genuine competition between landline and mobile operators.

Many questions submitted to the NAVIfuture experts concerned the value network of LBSs. The dominant actors in the value network in 2005 were expected to be mobile phone operators. The position of mobile operators in the value chain was assessed as either extremely important or fairly important. Operators either provide the services themselves or purchase them from specialist suppliers and distribute a family of location-based products (portal). Teleoperators typically have a large customer base. The implementation of LBSs, and above all of roaming, calls for a strong investment by and status of the operators.

According to the panellists, the value network will next be dominated by device manufacturers, software producers and application developers, as well as actors offering integrated professional applications. The terminal (and thereby its producer) will occupy an important position, because it is the terminal through which services become a tangible reality. However, services are more important than devices (if there were no useful services, what would be the point of having a device?). Applications will initially emerge with the help of device manufacturers. From the business perspective, the driving force for development will be provided by device manufacturers, producers of positioning technology hardware, and operators. Builders of professional applications will be important in applications offered for the business world. In a few years, the situation may have changed, as services have found their respective markets.

The role of the suppliers of enabling platforms (middleware) in the value chain in 2005 was expected to be average or fairly important, but not very important; the reason being the personal data protection offered by the platforms. Moreover, the enabling platforms process and refine information and, thereby, produce value added to the service. Builders of these platforms will supply the software to the operators for integrating different types of services to the positioning services themselves. Platform service providers will often be network suppliers.

Many experts anticipated major problems in the near future. One of the more radical comments was that "The earning logic makes no sense and I

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**SERVICES are more important than devices.**

**THE READINESS of consumers to adopt LBSs was perceived as very low at present, which forefronts the importance of low prices and customer-friendliness in general.**

**IN 2005 positioning will constitute 3–5% of the total volume of the telecommunication sector.**

**IN 2005 the operators will have outsourced the development and the marketing of services to service integrators and developers.**

**EXPERTS estimated the average turnover of positioning and LBS to be around 121 euros per user of mobile phone or other mobile device in 2005.**

doubt it ever will.” The readiness of consumers to adopt LBSs was perceived as very low at present, which forefronts the importance of low prices and customer-friendliness in general.

The message of the bursting of the IT bubble has evidently gone home, because the responses focused a great deal of attention on customers. One of the questions was, who will eventually pay for these services? Doubts were also expressed about the existence of any real need for LBS. The two greatest problems in the sphere of earning logic were the grounds of billing, which should be transparent, and the price of the services. A related issue is that the transmission required by the services and their actual content will probably be billed separately in 2005. According to the experts, positioning will then constitute 3–5% of the total volume of the telecommunication sector.

Operators and equipment manufacturers are still expected to dominate the value chain in 2005, but from then on in the period extending to 2010, content producers and other independent service providers will become increasingly important actors in the value chain. This will lead to a situation where an increasing number of services of perceived benefit to users, such as navigation map services and the provision of geographic information on nearby shops, will develop and proliferate. Markets will come to be dominated by services capable of ever more flexible adaptation to user requirements. At the same time, actors must make sure that the service concept itself is transparent so that consumers can differentiate between the role of each provider in the service package, such as in the bill, for example.

One viewpoint that emerged was that, already in 2005 and after, the role of service integrators and developers will be crucial, because by that time, the operators will have outsourced the development and also in part the marketing of services to these actors. Some experts also expected that by 2010 most companies, regardless of their branch, could have an integrated mobile LBS in place in their operations, either on the intranet or in customer service.

On the other hand, many respondents were quite sceptical about the very existence of a separate value chain, because positioning will, they argued, be only a new additional feature of mobile data management devices, one without any special intrinsic value. Even in this case, operators and positioning equipment manufacturers are left with great responsibility, but also cash flows for enabling and facilitating positioning.

What would be the scale of such business in 2005? Experts estimated the average turnover of positioning and LBS to be around 121 euros per user of mobile phone or other mobile device in 2005. Users would be prepared to

pay for the services about 184–259 euros a year, if they are offered the right kind.

No single solution emerged for the method of pricing for location-based services. Several respondents expected that the price will be a combination of a flat monthly fee and transaction-based fee, which would be itemised separately, as currently in the phone bill. For instance, users would get map data for the monthly fee, and individual searches would be billed separately. Advertisers could get themselves added to the database (pizzerias, chemists, etc.) by sponsoring searches. Services involving purchases and information search, in particular, could be sponsored.

Initially most business will be charged per transaction, later on billing will be predominantly per month or year. For professional users, a flat monthly fee may be a better solution, especially in heavy use. Because professionals use positioning to achieve cost-effectiveness, price is not a consideration as much as in public consumer applications. All the above-mentioned pricing systems are expected to be in use in 2005.

Content is expected to be the greatest single price component in the services. The device and software will account for some of the cost. Content and software are the two largest cost items, because they require constant input of human resources to be developed. It is the geographic information in services that costs money, not actual positioning itself.

Positioning devices will in 2005 be primarily paid by the consumer or the employer. The consumer will pay when the employer does not – as currently in the case of mobile phones. It is not expected that the operator would pay for the device. Positioning and the related service may also be paid by an advertiser (operator). In professional and corporate use, the service will always be paid by the employer.

Pull services and services for children will be paid by the consumer. Advertising services will be paid by advertisers, who will also pay part of the services connected with purchase transactions. Push services will usually be paid by the advertiser. The advertiser does not necessarily pay for the entire service, only part of it, as a sponsor.

**IT IS the geographic information in services that costs money, not actual positioning itself.**

**THERE IS still uncertainty about which will be the predominant positioning technology of the future.**

**EXPERTS stressed the crucial importance of standardisation of the technology for the emergence of a LBS mass market.**

## **3 TECHNOLOGICAL DEVELOPMENT**

### **3.1 POSITIONING**

Although positioning is an increasingly prominent part of the development of mobile technology, there is still uncertainty about which will be the predominant positioning technology of the future. The drawback of network-based positioning is its inaccuracy, its strength a potentially large user base. Satellite positioning is more accurate, but not quite as operable in urban environments and indoors. Other current drawbacks are large energy consumption and slowness of startup. With the development of WLAN and Bluetooth technologies, local positioning in city centres and indoors may become a new service opportunity.

#### **3.1.1 The Location of Positioning**

In the future, positioning and navigation will be increasingly prominent features of mobile devices. Yet it remains uncertain, what will be the predominant positioning technology of the future. Whether positioning will take place in the device itself or on the network server is also an unresolved question. If it takes place in the terminal, users have at least potential control over positioning. If it takes place on the server, current practices and device technology will be reinforced.

Experts stressed the crucial importance of standardisation of the technology for the emergence of a LBS mass market. The different sub-areas and interfaces all require reliable and functional standard solutions, such as software, service interfaces and use of AGPS. Regarding the development of services, it was the view of the experts that the operators' positioning platforms should develop into comprehensive systems covering the service engine, positioning, maps, geocoding, privacy, user identification and billing. To ensure the right direction for the development, OMA architecture should be used in the standardisation of the services.

The development of markets also requires considerably more advanced devices and simple, reasonably priced basic services without excessive profit expectations or investments in "killer applications". What is needed is simply considerably more advanced and user-friendly devices than at present which

support data services and are equipped with graphic user interfaces, and adequate memory and processing capacities. Here, too, standardisation is vital to ensure sufficient accessibility for the services. At least in the long term, network-based positioning should also achieve better accuracy, for example, by using E-OTD technology.

The experts estimated that current user interfaces (keypad/keyboard, screen, mouse) will in somewhat more developed form (e.g. colours, two-way functionality) be dominant in 2005. Voice-controlled, integrated and ubiquitous technologies such as smart clothing and body interfaces will in 2005 still be emerging, even though the capacity for their realisation does exist already.

The NAVIfuture experts were asked where the positioning of the device will take place in 2005. The responses indicate that positioning can take place equally well on the network server as in the terminal device. Satellite positioning was expected to take place in the device and network positioning on the network. Positioning in the latest devices saves network capacity and increases personal data protection. The calculation of the position of old devices and services that utilise Cell ID, as well as local/indoor positioning that require accuracy, will take place on the network in 2005.

### 3.1.2 Positioning Technologies

Of the current positioning technologies, it was expected that satellite positioning and network-based positioning will be important or fairly important in the future, depending on the application. Local and indoor positioning will be less important. Satellite positioning will be the preferred choice of professionals and active people (car navigation) and “technology freaks”. Network-based positioning will be used in mobile phones mainly for search or information services, and will probably be a standard feature in handsets. Local/indoor positioning will be used in shopping malls and airports; the first indoor guidance services will be realised using Bluetooth technology.

Satellite and network-based positioning will have different target areas, their own specialised niches. On the other hand, the integration and flexible parallel use of different technologies will probably be the preferred alternative, but will perhaps not yet be a reality in 2005.

In the sphere of satellite positioning, GPS and AGPS were both expected to be important technologies. GPS will probably remain important because of its low cost and low adoption threshold. Experiments with pseudolites will be made to improve GPS coverage.

**STANDARDISATION is vital to ensure sufficient accessibility for the services.**

**VOICE-CONTROLLED and integrated technologies such as smart clothing and body interfaces will in 2005 still be emerging.**

**LOCAL and indoor positioning will be less important.**

**GPS positioning will be a “standard feature” in more expensive devices and an accessory in mass-market devices.**

**THE MAJORITY of experts expected that mobile networks will offer AGPS services in 2005.**

**WLAN and Bluetooth supported positioning will occupy a key role in the future.**

Most experts in the second Delphi round estimated that GPS positioning will be only an accessory in mobile devices in 2005. The grounds cited for this were greater weight, power consumption and price. GPS positioning will be a “standard feature” in more expensive devices and an accessory in mass-market devices.

Only a few user groups will need the high accuracy of DGPS, which will remain relatively rare, especially as the signal is not always free.

AGPS may become popular among users for whom “time to first fix” is critical. AGPS is the superior technology in situations of poor reception, and it also allows indoor operation. As one expert observed, traditional GPS receivers will disappear almost completely from mobile devices, because of the benefits offered by AGPS (power consumption, time to first fix, urban canyon effect).

One item in the questionnaire addressed critical obstacles to the spread of AGPS. According to respondents, the greatest of these are technical functionality, construction of infrastructure, infrastructure investments, technical requirements of terminals, price, lack of applications (=services), and indoor coverage. The lack of standards was also mentioned as a factor.

Nevertheless, the majority of experts expected that mobile networks will offer AGPS services in 2005, even though the majority of users will not take advantage of it. The service will be primarily provided by operators, but also by independent service providers. According to one of the experts, however, its adoption will require several actors in the value chain and be, thus, slower than in the case of satellite positioning. Satellite positioning will have a strong position owing to its accuracy and because of roaming problems in network-based positioning. Galileo will strengthen the status of satellite positioning and GPS chips are also expected to become less expensive

However, the responses seem to indicate that all this is taking place very slowly – current multiple standards and infrastructures have splintered the market into far too small technological and service enclaves. Consequently many respondents were very sceptical about the emergence of a mass market by 2005.

In network-based positioning, cell-ID-based positioning was seen as the most important technology of the future. CI is an established, reliable technology, and its accuracy is sufficient for most applications. On the other hand, there are many purposes where its accuracy is insufficient, decreasing its overall significance.

In local/indoor positioning, WLAN fingerprint was expected to be a moderately important technology. WLAN and Bluetooth supported positioning will occupy a key role in the future, provided the technologies become

more common. On the other hand, owing to the high energy consumption of WLAN, only Bluetooth will become common in local positioning and guidance services. WLAN will be used in professional applications on proprietary WLANs of corporations and institutions. Wireless LAN has the advantage that its critical components can be implemented in conjunction with other, more widely used services.

Local/indoor positioning applications were expected to be useful in, for example, shopping malls, fairgrounds, department stores, and bus or transport terminals, as well as in industrial plants and warehouses. Local information about shopping malls and transport terminals are a natural part of positioning services. On the other hand, many institutions, buildings and shops are so small that there is no need for positioning. Because services will first be implemented in environments where there are paying customers, local/indoor positioning in hospitals or museums will not be the first to develop.

### 3.1.3 Accuracy of Positioning in Different Environments and Services

The accuracy of satellite positioning in good conditions is 10 metres at present. Traditionally, it has been possible to improve the accuracy of satellite positioning using real-time correction data. Correction data is transmitted by radio either via link masts or satellite (WAAS and EGNOS). DGPS positioning can in favourable conditions reach an accuracy of about 2 metres, but only some devices support the technology. The accuracy of network-based positioning systems varies with the size of cells; for CI positioning, it ranges from about two hundred metres to several kilometres. Some network technologies currently reach an accuracy of 50–200 metres and even better in third-generation networks. Network and satellite positioning will not offer great accuracy for indoor navigation or navigation in similar urban spaces. WLAN will spread quickly in offices, hotels, transport terminals and other public spaces, as well as in city centres. Bluetooth technology was designed to replace connector cables between devices, and to serve as a personal area network for mobile users. Bluetooth also offers an opportunity to locate a device that hooks onto the system with an accuracy that corresponds to the range of the device.

The experts were asked to estimate the accuracy of positioning technologies in different environments. Satellite positioning was expected to be the most accurate, the next was local/indoor positioning and the third network positioning. The accuracy of satellite positioning was estimated to be an average of 5.2–9.4 metres in open terrain, 16–22 metres in urban centres, and

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**"THE MORE accurate the service, the lower the threshold for paying for it."**

**STANDARD interfaces between operators and service providers will be fairly common in 2005.**

28–36 metres indoors. The accuracy of local/indoor positioning was estimated to be 19.4–53 metres. Network-based positioning was expected to be from 1.117–1,183 metres in rural areas, 134–146 in urban areas, and 69–81 metres in city centres.

Panellists were also asked to estimate the adequate accuracy of local/indoor positioning. The responses indicate that adequate accuracy depends on the application; for some applications, it will be in the range of centimetres, for others a few metres. On the other hand, it would seem there is perhaps no such thing as adequate accuracy; people will demand ever better accuracy as they first become accustomed to the less accurate system. Responses for the accuracy requirement spread out over a range of 10 metres, with clusters in the (1 metre, 1–5 metre and 5–10 metre categories).

The accuracy requirement for services was perceived as a moderately important factor. The requirement varies with the service and use. The need for accuracy is especially important in professional applications, but also for those users who pay for the service out of their own pocket. The accuracy in consumer services must be fairly great. High accuracy is essential for pull services, but not as important for push services. According to experts, the greatest accuracy is required in indoor navigation (see passage above). "The more accurate the service, the lower the threshold for paying for it." On the other hand, for official use, the accuracy of the nearest base station may often be enough, at other times the required accuracy may be as little as one metre.

#### 3.1.4 Location Roaming

The status and role of location roaming in network-based positioning was estimated to be moderately important or very important. In professional use, roaming is a precondition for profitable operation. Location roaming is expected to have the same kind of impact for the creation of markets as mobile phone roaming. Customers expect the feature to be functional and are disappointed if it is not. Because LBS is characteristically a service for mobile people, users will mostly need the service abroad, not on their home ground.

#### 3.1.5 Standards and Open Interfaces

The transmission of location data between teleoperators and value added service providers is an absolute requirement for the markets to function. Standard interfaces between operators and service providers will be fairly common in 2005. Without standards, the market cannot develop an important status. The

significance of open interface standards for the creation of successful services and markets was, therefore, considered crucial. They are essential for users to be able to access the services flexibly with different devices within the infrastructures of different operators and other actors.

Open interfaces create a unified market, where customers can choose between companies operating at different positions of the value chain. They are, in practice, a necessary requirement for the creation of consumer/mass markets. Vertical/professional solutions and applications are largely based on closed interfaces, but these will gradually be dispensed with as the markets mature.

### 3.1.6 Positioning Technology Problems

Several positioning technology problems were identified in the survey. Most respondents considered the price of positioning as the primary issue. Other problems mentioned included reliability, accuracy, indoor coverage, ease of use, accessibility, and the compatibility of equipment, software, services and networks. Many respondents also mentioned data security and the protection of privacy as special challenges.

## 3.2 DATA TRANSMISSION AND DATA FORMATS

The most important technologies for wireless data transmission are SMS, cell broadcast, GSM Data call, HighSpeed Data call, GPRS, EDGE, UMTS, Digital TV, WLAN and Bluetooth. Current mobile phones mostly support text messaging and data calls. Support for fast data calls varies both with the type of device and with the network. Mobile phone networks already offer GPRS quite widely, but there are as yet relatively few phones that use the function. Compared with other transmission technologies in mobile phone networks, the superiority of GPRS rests on a continuous connection with no dial-up delays. Network positioning can be integrated with all data transmission technologies now or at a later date.

EDGE is the next step in the evolution of the GSM network, based on a different modulation technique and offering potentially much faster transmission rates. The technology is still under development and requires investments both in the network side and in new terminals. The third-generation

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UMTS network will offer significantly higher transmission rates than GPRS. Experts estimate that the new service will, for a long time, be available only in major cities and only later spread elsewhere, with a more modest capacity. Because of the slow growth of their geographic coverage, both EDGE and UMTS are expected to first emerge as an accessory feature in new GSM devices.

WLAN currently offers, in practice, transmission rates of 11 Mbit/s, which is divided among users within the range of the base station. The technology will become more common in offices, industry and hospitals, as well as in hotels and public facilities, such as airports. Bluetooth's transmission capacity is about 300 Kbit/s upstream and 700 Kbit/s downstream. The technology was originally designed to replace cables between different IT devices. An increasing number of new mobile phones and PDAs support the Bluetooth technology.

Traditional protocols for mobile data transmission are SMS and WAP. HTTP is also common in data calls on packet radio networks, but the slow connection makes transmission sluggish. An emerging parallel service to SMS is MMS (Multimedia Messaging Service), which enables users to send messages in richer formats, at least between devices supporting the technology and traditional Internet e-mail systems.

The Location Interoperability Forum (LIF) has developed a Mobile Location Protocol (MLP) dedicated to location data transmission. MLP is designed for transmitting location data from location servers of the mobile phone network to the applications of value added service providers. The WAP Forum has specified a specialised protocol for transmitting location data from the terminal or location server to the application.

HTML, the general information format on the World Wide Web, will be gradually replaced by XHTML based on XML. WAP services utilise the WML (Wireless Markup Language), which is an application of XML. XML offers a more powerful tool for presenting structured information than HTML, which is restricted to controlling the appearance of the information. For the purpose of transmitting structured location data, OGC, the Open GIS Consortium (GIS, Geographic Information System), has specified an XML-based GML (Geographic Markup Language), which has also been proposed as an ISO standard on the agenda of the TC211 (Geographic Information/Geomatics). For visualising location data presented in GML, an SVG format will be used for transmitting graphics.

### 3.2.1 Transmission and Exchange of Data Between Devices

The NAVIfuture experts also assessed data transmission methods on the basis of their significance for the future of navigation. GPRS and WLAN were regarded as important, SMS as moderately important. GPRS will probably be the dominant technology in 2005. It is reasonably fast and inexpensive, and there are devices already available at this time. As a wireless and inexpensive technology, WLAN will also probably become more common, first in home networks. SMS is a familiar format enabling the provision of services based on simple queries, and it will probably hold its position also in the future. MMS will in all likelihood narrow the gap to SMS.

Two formats were offered as the most likely options for the transmission of location data between devices, location servers and value added services: XML and HTTP. The transmission interfaces defined by LIF (included in XML) also gained much support among the respondents.

The experts also assessed the methods for transmitting applications and content to mobile devices on the basis of their significance in the future. Downloading data from the Internet onto a PC was estimated to be a very important method. Moderately important methods were transmission from a CD/DVD on a PC, and wireless transfer with GPRS (and WLAN). High-quality navigation software with map data is available in CD/DVD format. Alternatively, it can be downloaded from the Internet onto a PC and then transmitted via cable or wirelessly to the mobile device. Small applications and content will be transferred wirelessly using GPRS. WLAN will serve mainly portable computers. Bluetooth hotspots will also begin to appear for downloading.

### 3.2.2 Data Formats

The NAVIfuture panellists also assessed the importance of data formats and their status in 2005. XML, XHTML and HTML were graded as important, and SVG a moderately important format.

XML will become an increasingly common format for transmitting data between applications (one instance of XML is GML for location data transmission). One benefit of XML is its flexibility. The challenge of the future will be to use XML to present the same data elements in several different formats, which means there will be demand for conversion services/software. HTML will be used on the traditional Internet for a long time to come. XHTML will probably

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increase in popularity as the range of devices grows, just as SVG and GML will do on the GIS side.

### 3.2.3 Service Formats

The experts were also asked to estimate, which service formats will be used in the future. MMS, SMS and WWW were scaled as important. SMS will probably hold its place because it allows easy service provision, although low usability will cause problems. MMS was graded important, provided usability is good, and because MMS enables using visuals and sound in the message. MMS is a natural extension of SMS. Some of the respondents reminded that WAP will also have a status; it will just take time for people and service providers to discover it.

### 3.2.4 Pull and Push Technologies

As their names imply, users either pull a service, or a service/message is pushed to them. Pull technology is used in applications when users know where to access the service. It can be used for finding information about companies or venues, routes, maps and address information. Push technology will be used in advertising and marketing applications and in automated professional applications. It is suited for use in fairs, advertising, transport tracking or for calling a taxi.

The role of push and pull technologies divided the expert opinions into negative and positive ones. Pull was expected to be the most common technology in 2005, with push used mostly in specialist applications and at work. The preference of pull over push may be also attributable to its controllability: people want to be able to control the information they are being sent. There will be pull services available, but few people will recognise the need or remember the service. For pull services, it is important that they are gathered into portals, and their use billed on a monthly or yearly basis. The advantage of push technology is easy usability, but the downside is that the recipient may not want it; compare the above-mentioned lack of control. As one respondent put it, push may become the “swearword” of the future.

### 3.2.5 Using Applications in Mobile Devices

Most of the NAVIfuture experts expected applications in mobile devices to be both pre-installed software and accessed from the network. Some applications

should be installed in the terminal, but some accessible from the server. Applications should also be downloadable according to need. On the other hand, one view was that applications will be mostly pre-installed software in mobile devices, but the services accessed. Devices can have an operating system that enables the use of different types of software. Simple and light applications will primarily be accessed from the server.

### 3.2.6 Transmission Problems

Several transmission problems were identified. Speed and price were the problems mentioned in most responses. Others included difficulty of use, problems with data security, with roaming, capacity optimisation, and problems due to weak coverage in rural areas in different countries.

## 3.3 DEVICES

Mobile devices are developing rapidly. Positioning devices of the future can be divided into car navigation devices, GPS navigators, PDAs, mobile communicators, and GPS wrist devices. Mobile communicators are increasingly beginning to resemble PDAs and vice versa. Their processing and memory capacity are increasing. Power consumption has been the bottleneck for the introduction of colour screens and more powerful processors. Bluetooth would allow components to be decentralised, but it remains to be seen whether users want a single compact device at all.

The capability for network-based positioning is an inbuilt feature in mobile communication devices. Network-based positioning technologies that aim at greater accuracy than CI-based positioning require the presence of the application on the SIM card or, most often, upgrading of the mobile communicator software (which in practice necessitates the purchase of a new device, as few upgrades are available). Satellite positioning will be used primarily with dedicated GPS navigators and car navigation devices, although GPS locators can also be hooked up to portable computers and PDAs. There are now many GPS devices on the market that can be connected to PDAs, and which cannot be used without the PDA. GPS has also been integrated with mobile phones, and the navigation phone market can be expected to see new products and new competition.

**SOME applications should be installed in the terminal, but some accessible from the server.**

**SATELLITE positioning will be used primarily with dedicated GPS navigators and car navigation devices.**

**BLUETOOTH and WLAN positioning will not be popular services.**

**THE PRICE of vehicle navigation devices will, in the future, fall to half or even less.**

### 3.3.1 Positioning as Standard Feature vs. Accessory in Mobile Devices

According to the NAVIfuture experts, mobile positioning in 2005 will be primarily an accessory to mobile devices, as well as a basic service of the mobile phone network. Positioning was identified as the most important of the new service paradigms that will be offered in mobile devices.

Network-based positioning will be widely used in mobile devices in 2005. GPS positioning will be a popular accessory used to enhance accuracy. It will be an accessory, because not all people will want it owing to its increased weight, power consumption and price. Bluetooth and WLAN positioning will not be popular services, although Bluetooth may become more widely used in museums and similar public places.

### 3.3.2 Different Devices as Locators

The experts were also asked about their views on the importance of different types of device as locators. Car navigation devices, PDAs and mobile phones were estimated to be the most important location devices.

The use of car navigation devices will increase in Western Europe faster than in Finland. As the equipment level of cars increases, vehicle navigation devices will also become a standard feature. Car navigation devices will be in competition with PDA-based locators. The latter will be based on a combination of “onboard” and “offboard” solutions, which are already in the PDA and route guidance accessed from the net. Positioning can also be a PDA accessory. The price of vehicle navigation devices will, in the future, fall to half or even less.

By 2005, the difference between PDAs and “advanced” mobile phones as navigation devices will disappear. A standard phone alone will offer simple SMS and WAP services based on CI-positioning. PCs will be used for accessing information beforehand and to support PDAs in downloading data. Integration of mobile phone and PDA would seem to promise ever greater opportunities for using navigation applications in them.

On the one hand, PDAs and mobile phones were expected to remain separate devices, communicating with each other through Bluetooth, or on the other, to merge into one device. No single best model or alternative was expected to have emerged in 2005. The range of different devices will in any case be extensive, although the differences will narrow in the next 5 years. A few respondents mentioned smartphones, which were expected to become more

common by 2005. The screen will make devices bigger. However, not all people will want to carry a “shoebox”, which means small phones will have a market in the future as well. All devices will have a different optimal size, form and use.

### 3.3.3 The Development of Navigation Devices

The development of navigation devices will continue to be lively in 2005. We asked the NAVIfuture experts about improved processing power, memory capacity, developments in screen technology and power consumption.

Increased processing power will mean GIS and multimedia applications, as well as visually impressive and ever more complex applications. It will also increase the capacity for implementing signal-processing applications (such as interfaces using speech synthesis). Mobile devices will be able to handle increasingly complex tasks and downloading and installing software into the device will be more common. But there are also disadvantages to increased processing power, since it easily leads to increased power consumption.

Increased memory capacity means that more downloaded data can be kept in the memory, such as map data and customer data (visuals, sound). Increased memory also allows more graphics and colour to be used, as well as heavier applications. Moreover, more memory gives an opportunity to carry different user profiles and identifiers.

Improved screen technology means the devices will be less expensive, facilitating their spreading. Colour screens will be more common, with better resolution. Large, accurate full-colour screens will become feasible, enabling the transfer of more functionality from the workstation to the mobile device. High-resolution screens enabling more graphic applications will also broaden the supply of applications. Better screens will allow maps and videos to be viewed without making energy consumption prohibitive or decreasing portability.

Power consumption in mobile devices was seen as a major consideration, even greater than at present. Power consumption continues to be a critical factor, because battery technology is developing at a slower rate than the development of electronics would call for. High power consumption may be a factor that prevents continuous positioning and other continuous use of the device. Device manufacturers dislike integrating power-consuming components in their products. Power consumption is accepted more readily in the case of PDAs than phones. In cars, this is not a problem, which means that vehicle navigation applications will be more advanced than other mobile use.

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**LINUX will continue to be an OS for enthusiasts.**

**SYMBIAN will probably beat both Linux and WinCE as the more efficient product.**

**STANDARDISATION is the only way of improving the reliability of large-scale multi-supplier solutions.**

### 3.3.4 Mobile Device Operating Systems

Mobile devices are developing into increasingly open environments, and a major competition for mobile operating systems has already begun. At first, PalmOS and EPOC (now SymbianOS) competed in the field of PDAs. Microsoft's WindowsCE 2.x was considered too heavy and was replaced by PocketPC (WindowsCE 3.x), which has become familiar in Compaq iPaq and HP Jordana, in particular. Nokia's earlier communicator model used the Geos operating system, and the current model uses SymbianOS. There has been interest in using Linux in PDAs, especially in Japan.

The experts were asked to estimate the importance of the operating system and its status in the mobile device environment in 2005. SymbianOS (former EPOC) and PocketPC (WindowsCE 3.x) were graded as moderately important. Because of its openness, SymbianOS would seem to be one of the most interesting operating systems in the next few years. Many equipment manufacturers support Symbian. Linux will continue to be an OS for enthusiasts, but can also increase its share if its usability improves. PalmOS will probably remain important in the USA, while PocketPC will remain in the game because of backing from Microsoft and the ubiquity of Windows. Symbian will probably beat both Linux and WinCE as the more efficient product. On the other hand, PocketPC may well gain in the market, because of its more standardised interface, as Symbian is still finding its form and offers too much variation.

### 3.3.5 Application Languages

The programming language of 2005 would seem to be Java. C and C++ will retain their status as the preferred language for heavy applications. Java will be important, because it is "easy" and most browsers support it already.

### 3.3.6 Open Standards and Software Interfaces

Open standards and software interfaces based on them were graded as important or moderately important. Standards and open interfaces facilitate the work of application developers and are an important factor, because fragmented markets cannot develop into major markets.

Standardisation is the only way of improving the reliability of large-scale multi-supplier solutions (so as to be verifiable and credible also in practice) and their stability, and for pushing markets into a direction where the

risks of long-term and relatively larger application-level investments can be controlled.

### 3.3.7 User Interfaces

The user interface of mobile devices is a challenge for product development – especially for network service providers, who would rather supply their services under a common standard. The problem has been addressed in standardisation work by developing methods that communicate basic information about the user environment (UAProf, User Agent Profile).

Mobile device screens have for a long time been monochromatic, whether in a mobile phone or a PDA – although in the future more and more devices will have a colour screen. The screens are also of different sizes and employ different aspect ratios. The keypad is small, there is an unusually small number of keys or the keypad is missing altogether. Applications are controlled either using a keypad and consequently also menu hierarchies, or alternatively on a touch-screen interface.

Voice interfaces have already been integrated in vehicle navigation devices and are making their way into mobile communicators as well. While handsets are naturally akin to an ordinary receiver, integrating voice-recognition in a mobile device is challenging, owing to high levels of ambient noise, for example.

The NAVIfuture experts were asked to grade the importance of different forms of user-device interaction, and their relative status. Among the very important interface patterns mentioned were the screen, keypad, loudspeaker and voice-recognition. Touch screen was assessed only as moderately important.

Screen technology is developing quite rapidly and the importance of visual information is on the increase. The screen will remain an important or moderately important factor, because a visual format allows more complex information to be presented. Pointers emulating a mouse are difficult in mobile use – improving keypad/keyboard ergonomics and standardisation will get better results. Touch screens will be widely used in map and entertainment applications and in guidance applications. The downside of touch screens is low durability and high price, and the difficulty of typing on the screen. Unless the screen is fixed in a holder, one needs two hands to operate it.

Voice interfaces will be more and more common, or they will at least exist around 2005. Voice interfaces require much more processing power than at present. Voice control will be of major importance in vehicle applications in particular, because it is the only safe way of operating devices. Voice inter-

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**TOUCH screens will be widely used in map and entertainment applications and in guidance applications.**

faces will be used not only in transport applications, but also for user groups with special needs. The proliferation of voice interface is limited by low technical functionality; in mobile use, interference from and to the environment is exceptionally difficult to control. The technical problems will probably still remain unsolved in 2005, which severely restricts their spreading.

The keypad/keyboard is the preferred interface for applications that require writing. Old habits will have retained their importance in 2005. Awkward keypads will probably decrease in the future, to be replaced by touch screens and voice interface solutions, for example.

### 3.3.8 Problems with Devices

There are still problems with the devices, and will be in 2005. The NAVIfuture experts mentioned several problems, of which power consumption was clearly one that predominated. Many different types of interface, varying quality, increased complexity and size relative to purpose were seen largely as problems for users. Too many different devices and the integration of data transmission, processing, radio frequencies and services were mentioned as problems for application producers and corporations. Data security and viruses, for example, are a problem for everyone in the value chain.

## 4 SERVICES AND APPLICATIONS

Economic trends show that the share of the service sector in the Finnish GNP has been continuously growing. The same development takes place elsewhere. The crucial status and role of services for the development and production of technology is today an acknowledged fact. This means that application developers must adopt an increasingly customer-centred orientation. Technology is of no use, if the interface is not designed so that users can access information effortlessly and can adapt it to their own purposes when necessary. The increasingly active and prominent role of customers in the selection and adoption of products, discernible also more generally on the market, should also be reflected in the design and development of navigation technology applications and services. Generic, multi-purpose personal navigation services will include search and directory services, route services, environmental information services, map services, tracking services, and marketing services. Even hobbyists will have services developed specifically for them; for instance, the bird-spotting service is expected to be a major breakthrough.

### 4.1 LOCATION SERVICES

The crucial question for actors in the NAVI network is, of course, what will the status and role of positioning be on the mobile services market. Many experts remarked that the technology is soon ready for the production of location-based services. However, the problem with the application of location technology may be, first, that there is uncertainty at present over what consumers actually want from the services, second, what and how are they willing to pay for the service, and third, how will the ethical issues be resolved, such as to what purpose can service providers and other actors use the information they obtain on their customers' movements.

On a scale of 1-5, a clear majority of the NAVIfuture experts estimated the status and role of positioning in mobile services in 2005 to be four. Location technology in 2005 will be fairly advanced and, consequently, the central element in the future of mobile services. Basic location-based services will have begun to reach the great public, but have not yet developed into an everyday routine. Adoption will take place relatively slowly, according to some estimates

**THE INCREASINGLY active and prominent role of customers should also be reflected in the design and development of navigation technology applications and services.**

**THERE IS uncertainty at present over what consumers actually want from the services.**

**RELIABILITY of operation is especially important in the beginning, because users will quite soon be fed up with non-functioning services.**

**THE CONTENT of fairly widespread location-based services (such as guidance in an unfamiliar city) will have standardised to some degree by 2005.**

initially in professional applications (industry, emergency services, the police) and then in consumer services (route and map services, for example), provided the earning logic is sufficiently clear.

The future of mobile positioning is, therefore, dependent on the conditions required for a breakthrough in services produced on the market. Consumers will have no interest in purchasing the necessary equipment, unless there are functional services available that will benefit and enrich the user's life. The experts consequently emphasised that services for the private consumer must have a clear value added for the functionality. Reliability of operation is especially important in the beginning, because users will quite soon be fed up with non-functioning services. Services should, therefore, be extremely streamlined and easy to use at the initial stage.

From the experts' viewpoint, the issue revolves around the preconditions for the formation of cultures of use. When people are on the move, they are searching for the services they need, generally from a specific area. Using location services, users can locate themselves or the required area relative to the services they need. Certainly users will find the services they need easier if they know their own position and that of the service. Positioning can, therefore, be expected to facilitate the use of many traditional services.

We asked the experts for more detailed views about the future development of navigation services as seen against the background of maritime navigation services, which are very well established. They were fairly convinced that the content of fairly widespread location-based services (such as guidance in an unfamiliar city) will have standardised to some degree by 2005. By contrast, the role of anonymous positioning in the preparation of traffic forecasts in 2005 was not considered to be very significant. We also asked the experts how the services will be used in 2005, as downloadable applications or services accessed over the network. Both alternatives received nearly the same amount of support, with the network service option being fractionally the more preferred one.

We also asked the experts to assess the future development of merged services that utilise both indoor and network-based positioning, since there may be a potentially large market for such services. The experts took a very guarded view of the development of such markets, however. First of all, indoor positioning would require dedicated equipment and systems if the objective is to establish a technologically durable and cost-effective solution. This would call for large investments in the development of technology and applications. Existing location technologies are difficult to adapt directly in this field.

The prevailing view was that the value chains of merged services and the standardisation of technology are still very undeveloped and it is, therefore, difficult to see how they could be made into a profitable business. The technology is, then, still very undeveloped for the purposes of mass markets. In fact, practically no commercial products exist as yet. Moreover, many experts doubted whether there is any real need for such services.

One of the issues was the criteria for profitable services and possibilities of testing the necessity of services. First of all, services must naturally generate some kind of value added, whatever the service. Of course, this does not imply the necessity for some “perfect” packaged solution, or clearly identifiable need for the service. Before the advent of SMS, no one knew that people had any need to send text messages. It is also important to remember the fact, familiar from user surveys, that it is essential for users to participate and want to participate in the development of the product/need. On the other hand, many experts did see many obvious needs, especially in the field of security and information services.

Secondly, the experts stressed the need for user-friendliness from easy usability to billing. In other words, what is needed is a simple, easy, timesaving and functionally reliable service. Aspects that emerged concerning non-utilitarian use were that the services should be entertaining, interesting, customisable and up to date.

The third element that was noted was financial aspects for providers and users alike. There are already tested and reliable criteria for the commercial viability and success of the value added services on the mobile network, such as the percentage of subscribers who use services daily. From the consumer viewpoint, it is naturally important that the service is priced reasonably. In the mobile market, excesses in this regard occasionally do happen.

The relevance of the services should, according to the NAVIfuture experts, be tested already in the development stage in different contexts and cultures of use. However, some of them remarked that the real need for and, therefore, the relevance of business operations cannot be tested beforehand, except by bringing them out onto the market to be tested. One of the indicators of a relevant mobile location service is, according to one respondent, that “you find something in an unfamiliar place, or something new in a familiar place.”

**THE TECHNOLOGY is, still very undeveloped for the purposes of mass markets. Practically no commercial products exist as yet.**

**WHAT IS needed is a simple, easy, timesaving and functionally reliable service.**

**APPLICATIONS that answer some real need will most probably be successful.**

**VALUE added rhetoric may be seen as criticism against an excessively technological discourse, placing the satisfaction of customer needs, instead of technology or its opportunities, into the hub of development.**

#### 4.1.1 Service Types

The status and role of different service types were addressed in several questions. Finding services or places, as well as tracking services and location broadcasting, emerged as extremely important service types in many responses. Map services, route guidance, environmental information and mobile games were assessed as moderately important.

Services involving maps and finding things were deemed necessary or useful and, therefore, important. Applications that answer some real need will most probably be successful. For this reason, applications involving security and safety may become important. Also applications offering location-dependent environmental information may become popular.

Entertainment (games/dating/find a friend, etc.) is an exciting new application that appeals especially to young people and was, therefore, evaluated as important. LBS's were usually expected to be gathered into portals. The NAVIfuture experts did not refer to any other formats for gathering services together, as they will not be ready by 2005. Services on one and the same theme will be accessible from one place, and an application-specific portal system will be in place in 2005.

#### 4.1.2 Basic Services vs. Value Added Services

New location technology will at best offer consumers "real value added" available from the services. The rhetoric of value added services can be traced back to the 1980s, when the GSM standard defined value added services as services not included, but accessory to the basic service. The opposite of VAS is basic services, such as those offered in Finland by the national Posts and Telecommunications until the 1980s. The public service was offered to all people, regardless of place of residence or wealth. Value added rhetoric may also be seen as criticism against an excessively technological discourse, placing the satisfaction of customer needs, instead of technology or its opportunities, into the hub of development.

In the development of mobile location technology, value added services can mean many things. First, dedicated pay services and products can be developed for special groups (as opposed to universally available services). The benefits may accrue even to a single consumer. Second, value added services involve the idea of a win-win situation, where both customer and service provider profit. Third, consumers receive latent benefits that are realised only in actual use (cf. functional foods, where the benefit is quite abstract).

The experts were asked if positioning and location-based services should be developed as much from the viewpoint of universal basic services as that of value added services. The majority considered the services should be developed from both viewpoints. At first, the development will take place as value added services in keeping with the needs of various user groups. This process can lead to services that otherwise might remain undiscovered. Later on the services will become basic services, which are accessible to all. However, there are certain services, such as those involving public transport and safety, as well as route and guidance services, which should be basic services from the very start. Different types of products and services will be provided for different groups; the use of basic services may be quite common among the population at large, and the use of special services marginal even among marginal groups.

#### 4.1.3 Problems of the Services

What will be the main problems of location-based services in 2005? One potential major problem mentioned by the experts was the cost of the services, both for the provider and the end user. Consumers are not necessarily willing to pay the price required to generate profitable business. There was also a fear that large consumer masses are not willing to pay a separate price for services, in which case LBS would remain the interest of small target groups only. On the other hand, it was also expected that the undeveloped state of standards may lead to a situation, where the price of product development becomes prohibitive for business.

For the consumers, the main problem may be the reliability and applicability of geographic data with respect to the service provided and the users' needs. In other words, the question was, will geographic data be available of a sufficient accuracy in the services where it is really necessary? Problems related to mobile devices, such as size and screen characteristics, were also mentioned. The fear was expressed that the services produced would be poor content-wise: people may become excessively enthusiastic about the potential of some technology, without paying enough attention to the quality of the services and real needs. There were also doubts about the success of integrating separate services into overall services, such as combining location data with route guidance.

Potential problems were also seen in data security: what will be the popular reaction to the security-enhancing features of location technology? On the other hand, what will be the potential threat to personal data security?

**DEVELOPMENT will take place as value added services in keeping with the needs of various user groups.**

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**THE PROTECTION of personal data security may well become a hot issue in the future.**

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**THE NAVIFUTURE panellists expected there to be several applications, services or other forms of use based on MMS in 2005.**

We can already see that a parallel service to SMS will be a reality in the future. MMS (Multimedia Messaging Service) enables sending messages in richer formats at least between devices that support the technology and to traditional e-mail systems on the Internet. The NAVIfuture panellists expected there to be several applications, services or other forms of use based on MMS in 2005. The primary applications mentioned by the respondents were map applications, and applications allowing the use of a camera, as well as related applications, such as chat or dating. The penetration of the Internet into the terminal will be one of the most important applications of the new technology. Location-based images and applications facilitating tourism (route guidance) were also seen as potentially important.

**THE DEVELOPMENT of automated applications will undoubtedly speed up in the future.**

Visual communication on the consumer side is expected to be important mostly as entertainment. Searching for a sight or a plot that is for sale may become easier with the aid of visual information. A photograph sent from a mobile handset could include a map pinpointing the location of the user. On the other hand, the view was expressed that visual communication only brings added value to situations where the image comes as a surprise.

Utilitarian uses of visual communication will probably be professional, such as providing medical or maintenance services from a distance. Some experts also mentioned certain situations involving supervision and measurement, where the location of the image could be recorded automatically. Visuals enhance the functionality of map services. The experts also stressed that, just like graphic menus and other visual control elements replaced the earlier text-based user interfaces, so the proliferation of images could be crucial for increasing usability and thereby for awakening the interest of both professional as well as ordinary users.

A general observation was that visual communication can convey more information than verbal messages in critical situations, such as accidents. An important benefit might also be that visual messaging offers a faster way of grasping information than text-based services.

The development of automated applications will undoubtedly speed up in the future. There are already several applications where automation can be utilised. For instance, transport and prisoner tracking is already an every-

day phenomenon. Future applications can include access control at work and monitoring of the movements of minors and animals. Security services for travellers and other groups will probably be one of the areas where automated applications will be developed. Automation can also contribute to logistic solutions, such as when a warehouse runs out of an item, the event causes an automated message to be sent to the supply manager, or the fridge running out of some specific food triggers an automated message sent to the family's groceries list. Road tolls and entrance fees could be charged automatically, and also a pool taxi service could function as an automated application. Machines are already communicating more with each other than with people. This could have an application in diagnostics; an automatic message to the garage about failure in the car's electric system, or to the service company when the air conditioning fails, may be reality in the future.

### **4.3 PRODUCTION AND SUPPLY OF SERVICES**

#### **4.3.1 Service Supply**

Service supply will by 2005 probably take place vertically. The supply has to be as vertical as possible, for consumers' value added to be realised properly in the beginning. Readymade service packages may be offered initially, but soon customers will want diversity and will put together such services as satisfy their particular needs. Competition in business/professional solutions in particular will be vertical. On the other hand, some services will certainly be supplied in part horizontally, in part vertically; this depends largely on the service.

Location-based or location-dependent services will be mainly supplied by teleoperators, media enterprises and specialised service companies. Teleoperators and their specialised cooperation partners will at least initially have an important status. Operators will supply services, because they will already have invested in both the network and in network-based positioning.

The role of LBSs supplied by the public sector was seen from two different viewpoints. Most respondents considered the provision of location-based services as being in keeping with the role of the public sector, others considered it quite needless for the public sector to produce such services. The public sector already administers many types of location data that could be spiced up with positioning and be offered to consumers. The role of the public sector was seen as that of activator and creator of frameworks for other actors. Ac-

**ROAD TOLLS and entrance fees could be charged automatically, and also a pool taxi service could function as an automated application.**

**LOCATION-BASED or location-dependent services will be mainly supplied by teleoperators, media enterprises and specialised service companies.**

**THE USE of public sector applications should be non-profit or even totally free of charge.**

**THE UTILISATION of geographic information produced by users themselves was not expected to be widespread or significant in 2005.**

According to the respondents, there are many good applications that could well be implemented by the public sector. The use of public sector applications should be non-profit or even totally free of charge (such as emergency services).

The most important producers of local guidance services in 2005 were expected to be municipalities, cities, the state, shops and other commercial suppliers, such as fairs, for example.

#### 4.3.2 Commercial vs. User-Based Production of Information/Services

The utilisation of geographic information produced by users themselves was not expected to be widespread or significant in 2005. The option for this must be included in the services, however, to allow users to make private berry picking spots, driving route to the summer house, shopping tips, etc. available to other people or at least to be “committed to memory”. The possibility of exchanging information among users was seen as a positive feature, which can be of a fairly great importance to communities. One expert observed that in some cases it may be the only possibility for producing up-to-date information.

Derived from the above, another expert opinion: The interest of users in 2005 will still focus more on commercially produced content than that produced by users. When the market grows, that is, when there are enough users (=critical mass), the users’ own content will follow. Commercial services will create the markets and provide the model. User-produced content is often intended for a very small group.

The role of alliances in service provision was regarded as important or moderately important. Alliance-building is an extremely important feature in the early stages of development and in international business. Service supply must be sufficiently extensive to awaken the interest of users.

## 5 USERS AND CULTURES OF USE

Cultures of use emerge when the use of equipment or a service becomes part of everyday life in work as well as in leisure. A culture of use accommodates all those wishes and preferences, as well as everyday practices, through which the custom of using equipment and services develops. New products are created on the basis of existing products, which then supply the history of that particular culture of use. The most common starting point is that consumers seek optimal benefits from a new product for their own needs. This means that even play and entertainment may look like a sub-category of utility.

At best, navigation and positioning technology can develop into a culturally significant innovation that provides users with an opportunity to create a richer relationship to their environment. For example, the need-driven interest of “how to find the way in a new setting” can be replaced by the desire to “have an adventure near home”. The adoption of positioning technology may lead to the emergence of new, as yet unknown forms of consumption and product.

Positioning and navigation can be applied in very many different areas. The transport industry has been utilising positioning for a long time, and its utilisation will undoubtedly extend in the future. Transport chains extend also to indoor spaces: industrial plants, warehouses and shops, so there will be no lack of opportunities for indoor positioning.

Positioning can be applied to transport and travel in a myriad ways. Travellers need maps, but also information about particular sites. Navigation is such a central factor especially on water that consumers may well be willing to make some investment to acquire the necessary material. It is also clear that positioning can play a major role in various collective activities. Bird twitchers, fishing enthusiasts, mountain climbers, etc. can send others information about the right places. Knowledge of the whereabouts of one’s friends, children or dog can be experienced as an important thing per se.

The NAVIfuture experts estimated that by 2005 the greatest value added from the utilisation of positioning will accrue in the sphere of economic or operative benefits. However, experiences were expected to be nearly as important, and the third, albeit much less important, was status. Other possible sources of value added are social life and security. Most of the respondents considered

**NEW products are created on the basis of existing products, which then supply the history of that particular culture of use.**

**POSITIONING can play a major role in various collective activities. Bird twitchers, fishing enthusiasts, mountain climbers, etc. can send others information about the right places.**

**IN FINLAND, 23 per cent of the people will be LBS users by 2005,**

**POSITIONING is already used in many professional fields, and in 2005 it is expected to expand to cover a wider variety of professions.**

that user-produced location-based content cannot be expected to be available until 2008–2010. A minority placed the estimate between 2003 and 2006.

## **5.1 USERS OF LOCATION SERVICES**

The NAVIfuture experts were asked to estimate how many people out of a hundred will be using LBSs in 2005. The following figures are averages calculated from the replies.

In Finland, 23 per cent of the people will be LBS users by 2005, the figure for all Nordic countries will be slightly less, 22 per cent. The further south in Europe we go, the fewer users there will be; in Western Europe, the figure will be 19, in Southern Europe 15 per cent. In this respect, too, the experts estimated that Japan will be in a leading position in the future, with 31 LBS users in a hundred. The figure for the USA was expected to be more or less the same as for Western Europe, 19 out of a hundred. In other parts of the world, the number of users was estimated to be only 1.5 per hundred.

We also asked the experts to estimate which people will need and use positioning and LBSs in 2005. The general view was that positioning and location-based services will be needed most by professional users. Positioning is already used in many professional fields, and in 2005 it is expected to expand to cover a wider variety of professions (drivers, guards, care professions, etc.). In addition to professionals, many groups and communities will use LBSs in 2005. Tourists (adventure travel) and various enthusiast groups (orienteering, bird spotting, trekking, sailing) will use the services in 2005. Young, extrovert people and pioneer consumers with their technological orientation will be among the first to take up LBS. Use by “ordinary” consumers in 2005 may still remain slight/occasional. Some respondents even were convinced that everybody will need location-based applications in the future, in one form or another.

Of the sectors of the economy, those of transportation and warehousing were expected to utilise the potential of positioning and location-based applications and services to a very significant degree. Agriculture and forestry, industrial production, electricity and water supply, public administration, national defence, the real estate and business sectors will use a considerable amount of LBSs.

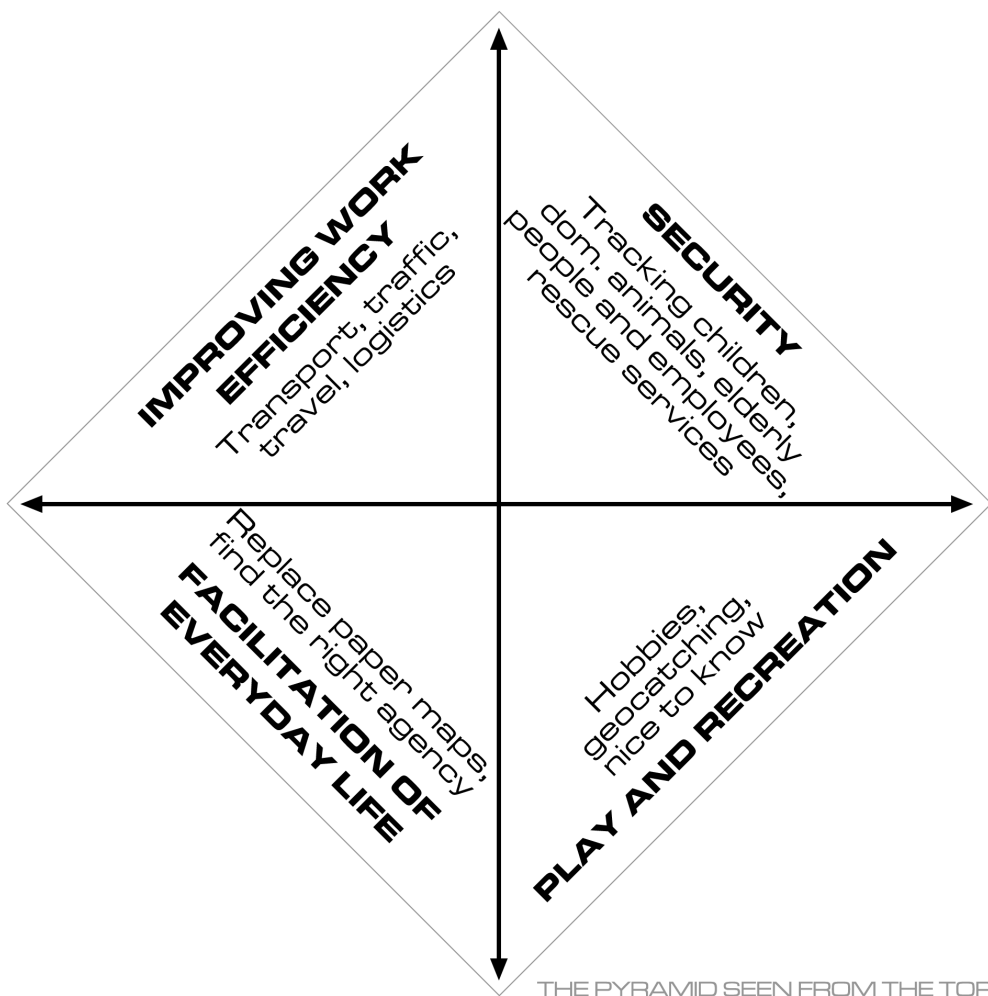
The general view was that positioning and LBS will be crucial for enhancing the efficiency of mobile work. Public transport and security services will, in the future, be significant users of location-based services. Public appli-

cations (public transport) will spread among consumers quickly, provided the price is acceptable. Emergency services were regarded as being of such obviously crucial significance (potentially involving human life) that their demand will be great for that reason alone. The utilisation of LBS in travel services may be considerable, because positioning can offer real benefits in foreign environments.

To sum up, we may say that positioning will be used to increase efficiency at work, in play and for pleasure, to increase safety and to facilitate everyday life.

**IT WILL be businesses who will benefit most from positioning.**

Figure 4. The users of positioning.



No single sector was seen to occupy a crucial role in the use of LBSs; businesses were expected use a modicum of B2B services, because pricing at both ends is easier. According to the experts, eventually it will be businesses who will benefit most from positioning.

**NOKIA** has used the following classification for grouping consumer segments:

**Trendsetters**

*desire to be at the leading edge of technology. This is expressed in their choice of the latest phone model.*

**Posers** aim to make

*a personal fashion statement. A poser would typically be a male or female who likes to be noticed and enjoys the cachet of a different and striking phone.*

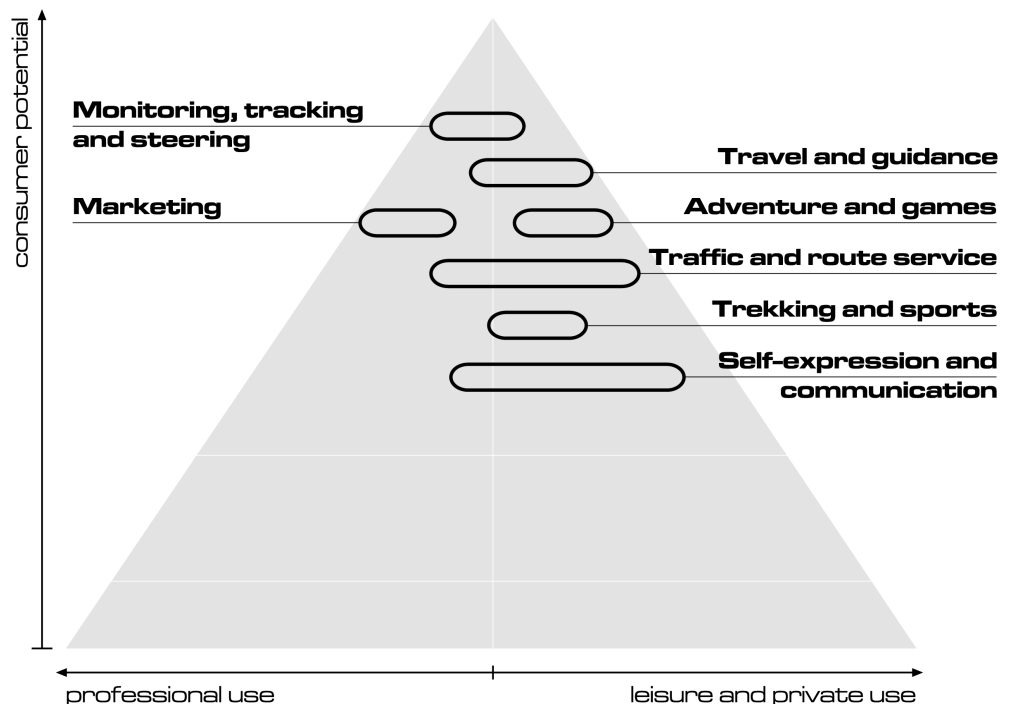
**High flyers** are typically the “heavy users” from the business segment.

**Social contact seekers** seek quality and reliability in an affordable package. They want to be able to differentiate themselves and reinvent their phone profile according to their individual taste and mood.

Source: Nokia (1999) CeBIT99 webmagazine, March 13-24, 1999.

The use of LBS by the public sector will be restricted by price, and positioning will be adopted there quite slowly. Its use will focus on rescue services and the police. Adoption by communities will be slowed down by contractual difficulties and the lack of appropriate payment models. Communities were expected to use positioning mostly for social purposes. Utilisation will still be slight in 2005. With respect to consumer potential, monitoring, supervision and steering applications were deemed very important, and travel and guidance applications moderately important. Applications that are in the concept stage, or those that are already in use, will all be in use in 2005. Everyday utility and professional applications have an obvious consumer potential.

Figure 5. The consumer potential of positioning services.



The experts were asked to assess the importance of LBS with reference to user groups defined by Nokia. The two most important groups were trendsetters, who follow the trends and are the first to acquire the latest devices, and posers, whose key values are aesthetics and visibility. On the heels of the posers come the high flyers, for whom the important things are efficiency and status. The least important group with respect to the use of LBS were the social contact seekers. The experts pointed out that, for the first two groups, the device is more important than the services it makes available. For the other user

groups, services and their potential for expansion take precedence, which means they may become the pioneers in the next wave.

We also asked the experts to consider the conditions under which senior citizens might in the near future become users of LBS. They were expected to be increasingly adept at all matters involving knowledge management, both because of their earlier experience and their general activity. By taking into account their needs and skills, senior citizens may in 2005 have developed into a very important user group. On the other hand, it was also observed that adoption of LBS must be much easier in the future, because terminals and applications must become simpler to use. One respondent emphatically made the point that there will be no progress until the design and concept building of the services is transferred from engineers to economists.

## 5.2 CULTURES OF USE

### 5.2.1 How Frequently Will Location-Based Services Be Used?

The respondents estimated that “average users of LBS” will use positioning once a week in 2005. Because people generally move in familiar environments, they usually have no need of positioning. But as soon as they go someplace else, they may require positioning up to several (dozen) times a day. Ordinary users will find the service in a portal, where other LBSs will also be available.

“Professional drivers may use an LBS several times a day; positioning will not be a standard feature in ordinary cars until 2010.” After an initial phase of experimentation, some users will feel that positioning gives them sufficient value added that they may use it a few times a day (young people).

### 5.2.2 When Will Location-Based Services Be Used?

People were expected to use positioning and location-based services more at work than leisure. Profitable turnover will be generated by occupational use, quantitatively significant (occasional) use takes place also in leisure time. People will learn to use LBS at work, and then the use will also spread to other areas. Leisure use will primarily be based on free or packaged operator services.

Leisure use was expected to be spasmodic: ten times one day, and then no use at all for a week. The use of LBS or positioning will not have become

**ADOPTION of LBS must be much easier in the future, because terminals and applications must become simpler to use.**

**“AVERAGE users of LBS” will use positioning once a week in 2005.**

**THE USE of LBS or positioning will not have become everyday routine in 2005, but perhaps in 2008 or 2010.**

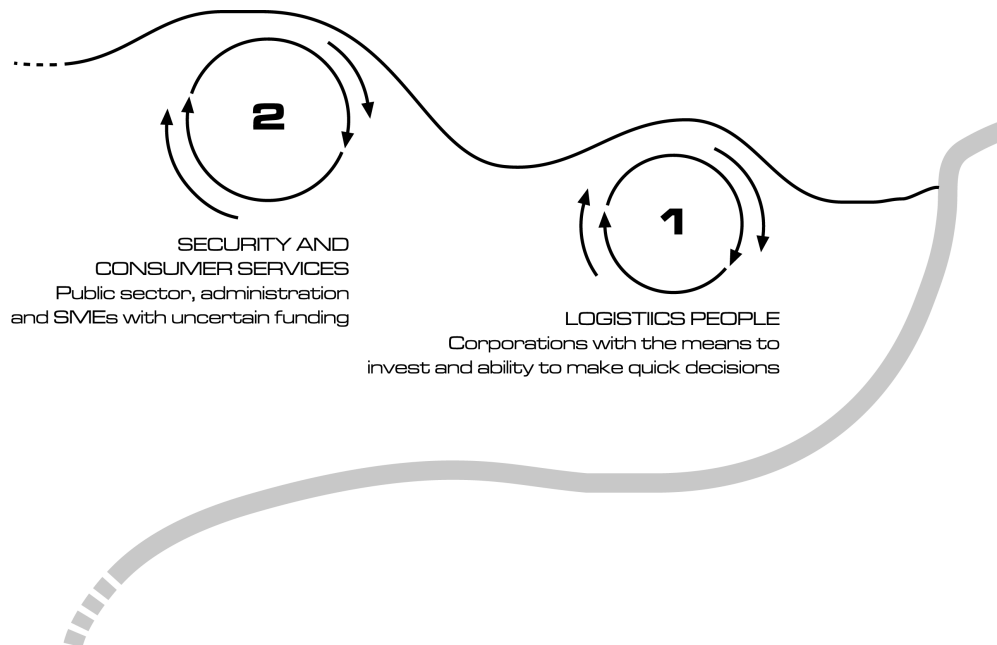


everyday routine in 2005, but perhaps in 2008 or 2010, when car positioning, for example, was expected to be a standard feature. The experts stressed that frequency of use will be completely dependent on consumer prices and the quality of the benefits accruing to consumers.

### 5.2.3 Evolving Use of LBS

The responses suggest that the use of positioning and location-based services can be divided into two waves, the first being the pioneer wave, the second the follower wave:

Figure 5. The two waves of positioning.



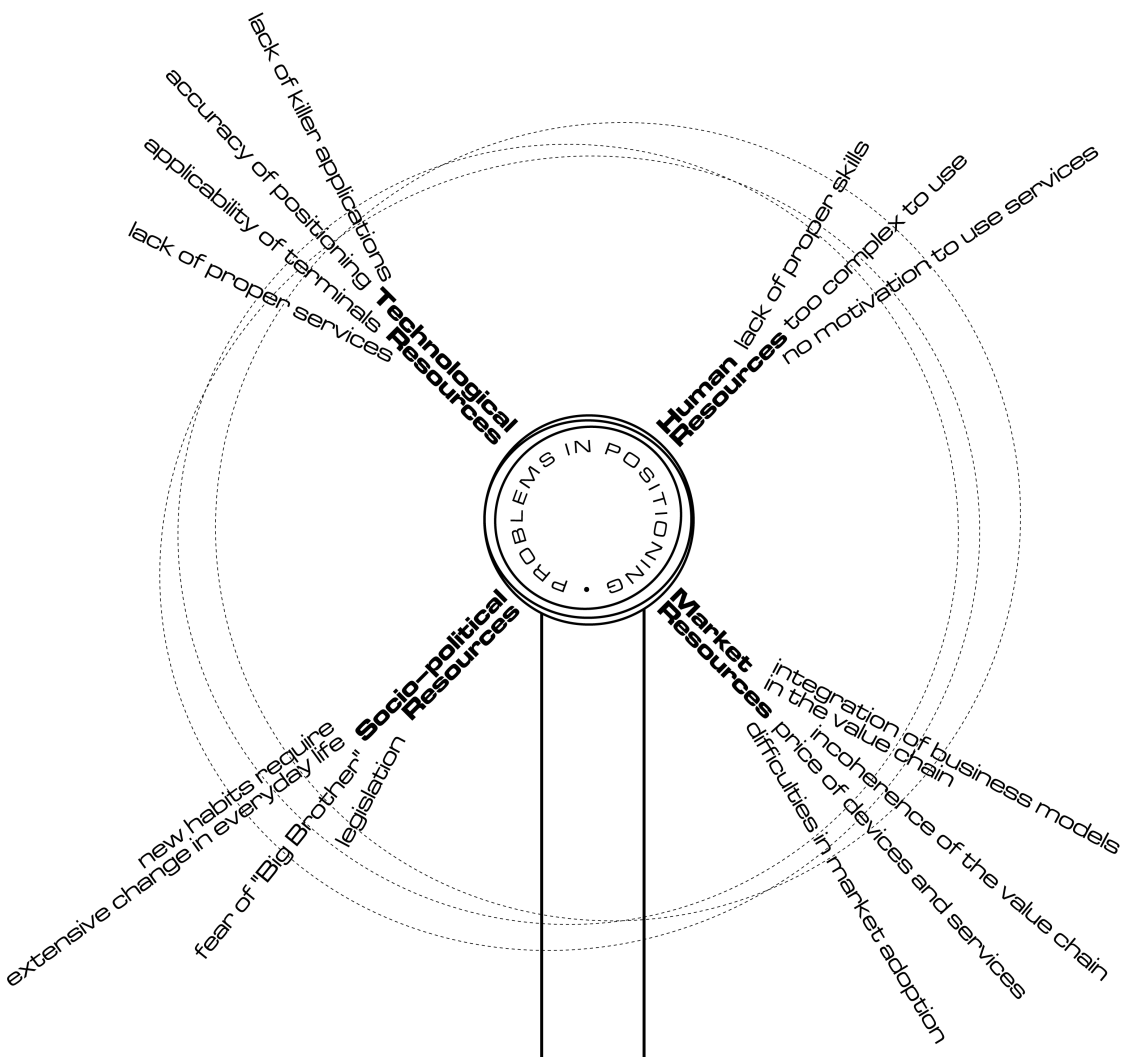
Wave I: Users who either use already, or think they will use the services soon. These are most often businesses and others dependent on logistics. The business sector has the resources to invest in and use new technology. This sector is also capable of making fast decisions about needed investments.

Wave II: Second-wave users will often be from the public sector or administration, for whom the funding of positioning is more uncertain and the budgets small (retail, accommodation, food, health care, fire and rescue services). Decisions in this sector are made slower and require the acceptance of many instances.

### 5.2.4 Problems in the Use of LBS

We asked the NAVIfuture experts to consider what might be the most important reasons or problems that may slow down, impede or prevent the adoption of positioning or location-based services. The identified problems can be grouped in four categories: technical, market, human, and social resources problems. The most often mentioned problem was the price of the device in relation to the service it provides. The second most common problem was expected to be the usability of services and user interfaces. Their development still requires time and effort. The third most common problem was expected to be the slowness of general adoption; the introduction of new routines in both working and private life takes time. Many experts also expressed doubts about whether the technology will not be used to build a new “Big Brother Watches” society.

Figure 7. The Problem Mill of positioning.



**LEGISLATION will be harmonised by 2005 at least in part, especially regarding data protection and standardisation.**

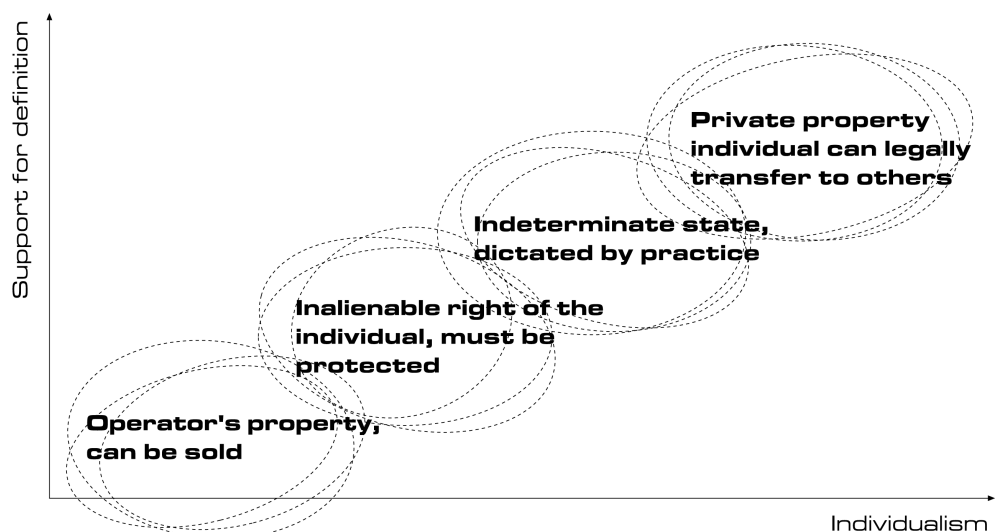
## 6 THE ETHICS OF POSITIONING

It is clear that, as location-based services develop and the commodification of profile types progresses, some very interesting judicial questions will emerge. These will, in the final analysis, concern the relationship between people and place. In addition to aspects involving privacy and the identity and scope of relevant regulatory instruments, the ethical evaluation of location technology was expected to include profound debate on the nature of the new target market.

According to the NAVIfuture experts, there may be considerable legislative differences in emphasis geographically and nationally, even though these will have relatively little general effect on the development of national services. Where legislation allows operators to offer easy-to-use location services, they will also spread quite rapidly. It was also expected that legislation will be harmonised by 2005 at least in part, especially regarding data protection and standardisation.

We asked the experts how best to define geographic data on private individuals. About half of the respondents were in favour of a definition whereby geographic data is private property, over the disposition of which individuals have legal discretion. On the other hand, one third of respondents considered that geographic data related rights are entirely dependent on the situation: In some cases it is personal property, in others that of the operators.

*Figure 8. The definition of personal geographic data.*



## 6.1 SETTLING POSITIONING RIGHTS AND INFORMING THE OBJECT OF POSITIONING

The NAVIfuture panellists expected that issues involving immaterial rights will be resolved in contracts (IPR, written, electronic) negotiated between the various parties, and through legislation, which is currently still in the process of formation and may be quite stringent. The procedures for settling the right to locate individuals in families, the workplace and different communities will involve oral and/or written agreements, discussion, arguments, cooperative negotiations and employment contracts. In communities, people may voluntarily allow themselves to be included on location lists.

In 2005, users must be informed about positioning with a request for permission, or by a warning "You are being located, please accept/refuse". In the future, users must be have the option of disabling positioning. The object of positioning must have access to information about who have located them and when. In other words, the object of positioning must, in one way or another, always be asked for permission to be located (except in the case of anonymous services). The permission can be granted on a case-by-case basis using e-mail, SMS, or, in ordering a service, in a contract between the subscriber and the service provider.

## 6.2 SITUATIONS WHERE POSITIONING IS ALLOWED

The experts were asked about in which situations or services operators should be allowed to provide the location of a specific, identified device. The respondents mentioned, in particular, emergencies, search and rescue missions and crime investigation. On the other hand, all people who have given permission to be located (find a friend, etc.) may be located. Positioning was also seen as necessary in corporate use, especially in applications involving mobile work.

The experts' recommendations for the protection of geocoded data included, on the one hand, contracts and agreements, on the other, technical systems, such as crypting, storage time limits, and user-specific discretionary threshold for supplying geocoded information about themselves. As one respondent remarked, there is a simple method for resolving this issue: users would always receive their location on their own terminal device and then be given the option of forwarding it to the service provider or other user by simply pressing a button (at no cost to the user). Nearly all respondents expected

IN THE future, users must be have the option of disabling positioning.

NEARLY all respondents expected that, in addition to legislation, the provision of geographic information will in 2005 regulated by agreements between users.

**WHAT if the registers were to end up in the wrong hands, perhaps in those of criminals?**

that, in addition to legislation, the provision of geographic information will in 2005 regulated by agreements between users.

### **6.3 LIMITATIONS OF POSITIONING**

There was a general feeling that positioning will involve fairly many or many restrictions. One instance, which was expected to involve a great many restrictions, was the locating and monitoring of customers. Employee tracking will be the subject of very thorough debate, and should be regulated by legislation or employment contracts. Moreover, legislation will probably restrict the positioning of various special groups. The positioning of employees and people in custody was generally considered more desirable than the positioning of children, for example.

Asked about whether some special groups should be legally protected from positioning in 2005, some respondents answered with a universal negative, others in the affirmative. According to some respondents, the police, leading politicians, high-ranking military personnel, supervisory authorities, children (except from families) and all those who do not wish to be located should be protected from positioning. One particular concern was the maintenance of location registers; what if the registers were to end up in the wrong hands, perhaps in those of criminals?

On the other hand, the experts were almost unanimous in that the data protection requirements for positioning will in 2005 probably have been taken into account in the standards for such systems. Positioning products will, in principle, support the standards, although mistakes will also happen.

### **6.4 POSITIONING RIGHTS OF THE AUTHORITIES**

The right of the authorities to locate people was expected to be neither very great nor very small. They would have the right in emergencies, cases involving gross criminal conduct and rescue missions. In such cases, they were expected to have unrestricted rights for positioning. It was estimated that geocoded data will in 2005 be used by the authorities under court order, just like phone-tapping permits are granted today. Nearly all respondents expected that, in addition to legislation, the provision of geographic information will in 2005 regulated by agreements between users.

One special issue was whether the police should be allowed the right to access the data of all mobile phone users who were close to the scene of a crime. Most respondents replied that the police should be allowed access to such information.

## **6.5 RECORDING AND MANAGEMENT OF PROFILE DATA**

The profile data of mobile device users will, according to respondents, be recorded in the terminal device and in the “archives” of the service provider/operator. On the other hand, the data could also be recorded in the application. The user of the service will have control of such data, in principle, or at least should have. In practice, it was expected that profile data will be managed by the operator/SP.

## **6.6 THREATS IN POSITIONING**

Positioning may become the target of criminal purposes or threats, which should be prepared for. Illegal monitoring of persons or vehicles and cases of espionage were mentioned in many responses. Thefts, robberies, kidnappings, car thefts etc. were also regarded as serious threats. The unauthorised use of location services, to be paid by someone else, and even excessive marketing, were also mentioned. One respondent referred to teleoperator personnel and their reliability as a great risk.

## **6.7 ETHICAL PROBLEMS OF POSITIONING**

The most prominent of the ethical problems of mobile positioning mentioned was loss of privacy and the submission of geographic information to third parties either as individual data or collated group data. Registers of geographic information constitute a resource that requires confidentiality in both management and storage. The use of confidential non-public information resources always involves the risk of abuse. One case could be that police, for instance, uses register information for engaging in extortion-like actions, using the object of the action as a tool for conducting unlawful crime prevention and crime detection activities.

**REGISTERS of geographic information constitute a resource that requires confidentiality in both management and storage.**

**KEY question is:  
Who is allowed to  
locate whom and  
under what circum-  
stances?**

The cause of concern is, thus, the archiving of geographic information and the risk that the registers might end up in the hands of criminals or other undesirable elements. From the ethical viewpoint, the key questions in this regard are: Who is allowed to locate whom and under what circumstances? What would be the sanctions for “illegal” positioning? As one respondent remarked, as long as the submission of geographic data is voluntary, no ethical problems arise.

## 7 CONCLUSIONS

The NaviFuture Project was as it happens undertaken at a time in 2002 when the so-called IT bubble, based on inflated expectations, had just collapsed. As a result, the attitudes of the respondents in the survey were perhaps exceptionally guarded in some respects. The experts had aversions to all kinds of “hype” and put special emphasis on need and utility. In other words, technological realism has made a comeback.

There was still faith in the breakthrough of personal navigation as part of the overall development of mobile technology, however. Some of the experts believed it will happen as early as 2004, others favoured some later date, 2008 or even later. There were also some who did not believe at all in the possibility of a breakthrough. The responses were quite clearly informed by a vision that the road to success in a mass market cannot always be smooth. A breakthrough is dependent on a considerable number of factors, all of which must be in place before it can happen: sufficient mass markets, functioning value chains, adequately productive business models, standardisation of service content, clear codes of conduct, etc. Although some of these elements can be expected to be in place soon, many key issues still remain unresolved.

Some other recent reports on the future of navigation show that elsewhere, too, there is faith in a significant market growth for positioning technology. A global market analysis and strategic review conducted recently by the ARC Group foresaw at least a tenfold increase in the annual use of location services by 2007, up to 300 billion transactions. This growth is not projected as a result of professional use, but of a radical growth in so-called infotainment<sup>1</sup>.

A study of the market development of mobile positioning conducted by Durlacher Research and Eqvitec Partners expects location technology to have developed as soon as 2003 to the stage where consumer services will make a real impact on the markets. However, this cannot take place unless mobile devices with GPS support become inexpensive enough for a mass market.<sup>2</sup>

Things are changing constantly on the market, however. According to most of our experts, the results of the project will be out of date in 2004 at the latest, according to some even sooner. On the other hand, we may with good reason also claim that the results of the project will be usable as a guideline in 2004 as well. The general trend in the future development of services could perhaps be sketched along the lines that professional use will undoubtedly precede mass volumes, also in the future.

In other words, technological realism has made a comeback.

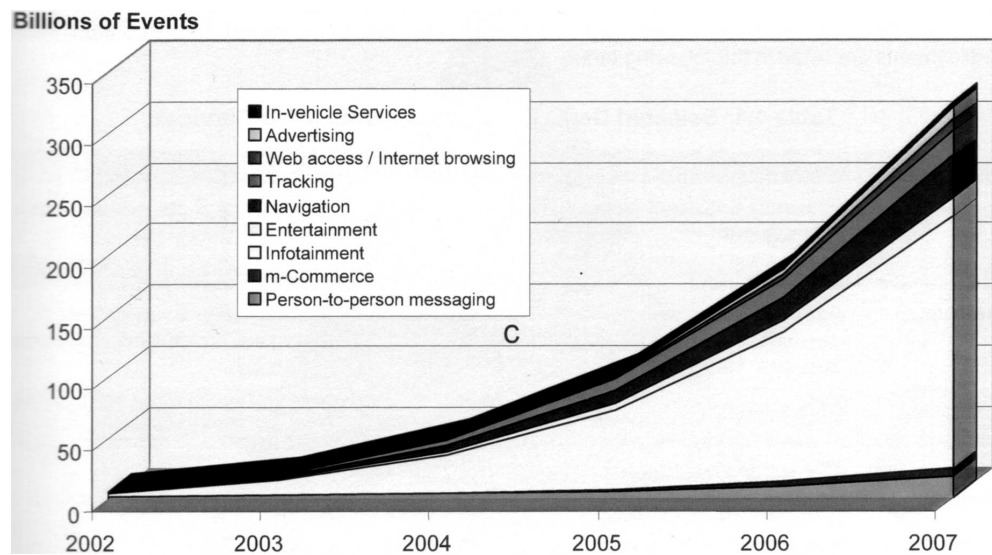
The road to success in a mass market cannot always be smooth.

Professional use will undoubtedly precede mass volumes, also in the future.



At any rate, the market for location-based services is diversifying.

Figure 9. Consumer LBS Volumes Worldwide (ARC Group).



At the same time, the earlier firmly held notion of positioning as a separate service or application has gradually eroded. Location markets started off with specialist applications, but in the near future positioning will increasingly be a service component in many different types of mobile services. This development will shift the focus away from operators and equipment manufacturers to developers of specialised applications, even though the role of operators will also remain crucial in the future. Location services will not be a goldmine for any of the parties in the foreseeable future, however.

At any rate, the market for location-based services is diversifying, and services will in the future be used in an increasing number of different ways. Service content, whether produced by services providers or users themselves, will occupy a crucial role in the future. It is also clear that consumers will increasingly participate in the creation of needs in the future.

Terminals will have to be considerably more advanced technologically for the services to be quick and effortless to use. The experts estimated that moderately priced simple basic services will be a much more important factor in the market than any “killer applications” requiring huge investments. It was

1 Location Based Services. Strategic Report. Worldwide Market Analysis & Strategic Outlook 2002–2007. Arcgroup, 2002

2 UMTS Report. An Investment perspective. Durlacher Research LTD & Ecqvitec partners Oy, (2002).

also estimated that, being a fairly fast and inexpensive technology, GPRS will in 2005 still be the prevailing transmission technology.

The experts also had a clear idea that pull technology will be more common and more popular than push, because it does not allow questionable coercive elements to be included in the service. The use of location services must, therefore, arise from the “free will” of the consumers. On the other hand, consumers may in this respect have a surprise up their sleeve; no one could foresee 10 years ago the extent to which people would “need” text messaging. On the other hand, the idea is still dominant that economic and operational benefits provide the most efficient motivational factor for using the services. Even more tangibly: from the perspective of consumer potential, monitoring, tracking and steering applications were estimated to be the most important of all services.

In the final analysis, the success of personal navigation in future markets seems to be subject to very basic factors. The technology must function seamlessly, and the services should be as simple as possible to use. At the same time, the provision of services must be on a much more profitable basis than at present. There is no doubt that people in the future will increasingly want an answer to the questions: Where am I, where are you, where do I find some specific place? It will be interesting to see whether in 2005 we will already have a market where answers to these questions can be easily obtained using positioning technology.

The use of location services must, therefore, arise from the “free will” of the consumers.

# APPENDIX 1

## ORGANISATIONS PARTICIPATED IN THE NAVIFUTURE PROJECT

Alma Media Net Ventures

Arbonaut Oy

Benefon Plc

Digia Oy

Ekahau Oy

Fortum Plc

Genimap Oy

Geoaudit Oy

Helsinki Institute for Information Technology

University of Jyväskylä/IT Research Institute

Ministry of Transport and Communications

Locus Portal Oy

Navinova Oy

Nokia Mobile Phones

Nokia Networks

Finnish Defence Forces / Technical Research Centre,

Division of Electronics and Information Technology

Radiolinja Oy Ab

Railtelia Oy

Sonera Plc

Space Systems Finland Oy

National Research and Development Centre for Welfare  
and Health

Suunto Oy

University of Tampere/Hypermedia Laboratory

Statistics Finland

VTT Information Technology

Population Register Centre

## APPENDIX 2

### COMMENTS TO THE REPORT

Fabienne Dricot (EU/DG IS) and Eiichi Washisu (Tekes/Tokio) combined and summarized:

**FD:** This is a well prepared and well presented document, it is easy and interesting to read. A very large amount of value added data is provided. The document is very dense and compact; a lot of topics are addressed in each paragraph; that from time to time would deserve more details or explanation. A question can be raised if a specific chapter on cost of services, earning and billing would have had its interest instead of providing information in the different chapters. Standardisation could also have deserved more specific attention. **EW:** It is very hard to find any "smell of Finland" in the report. It seems unlikely that this report will bring any significant impacts to mobil telecom industries. **FD:** One would appreciate a more thorough presentation of the experts having answered the questions e.g. their activities, education, the percentage of experts in the different activities, etc.

**EW:** Perhaps today's biggest markets for mobile telecom are US, Japan and China. Each of them has different trends in business applications and technologies. I hope you should learn each countries trends and facts by your own hands and eyes. Japanese telecom industries are busy in developing broadband services over 100 Mbps optical fiber access networks, not mobile services. The mobile services are matured economically today. And mobile network will also change to VoIP technology to survive in network services. Japan has huge number of car navigation system, mobile phones with colorful displays, manufacturers who can produce small-sized electronic equipment, and mobile internet services. So, Japanese mobile phone users are prepared for accepting personal navigation services. However, there is no killer service for personal navigations at the moment.

**FD:** First § on page 22, the example of E-OTD is not the best choice. The deployment of E-OTD technology encounters some difficulties, the expected accuracy of 50m/150m has not been fully met yet. Moreover there may be some serious commercial concurrence from AGPS1 Last § page 24, the accuracy of satellite positioning should be reviewed: for instance in open terrain the accuracy can be around 1 meter, also the upper value given for urban centre i.e. 22 m is very good for this type of environment.

**FD:** The fact to address the ethics and the peculiar topic of privacy in a specific chapter is excellent. It is too rarely the case. It could be of interest to indicate if such a work and report following the development of personal navigation should take place again and if yes, when.

Matti Mäkelin (Mäkelin Consulting Oy):

That the “text speaks by itself” is a good approach. Instead, I have to use some explicit references to back my comments. Another background remark is that as a consumer I regularly use (2002) these technologies and services in three ways:

- *Car navigation* abroad using Microsoft’s Autoroute 2002, a laptop and GPS card. The application is good and superb value for money (less than 40 pounds at Amazon UK). Unfortunately this product has not yet mapped Finland.
- As an active skier and trekker, during long day trips in summer and winter, typically from 50 to 100 km a day, I routinely use a *hand-held* GPS and a digital camera to *mark places*. For instance, I have thousands of digital photos from places during all seasons. If I were boating, I could use LBS also there. If an attractive community platform were available, I could well give all my coordinates, related stories and digital seasonal photos in the true meaning of “gift economy”.
- I often have to visit unknown places. I always key-in the address of the place (typically, a firm) to my 7650 that has [www.maporama.com](http://www.maporama.com) bookmarked. The quality of this map has turned out to be satisfactory even if it somewhat slow and dangerous (in traffic) to use the thumb-operated one-hand device. I have also bookmarked regularly visited traffic camera frames. For instance, when I wake up, the first thing I do every morning is to look at the weather - not from the window and the physical thermometer – but from the Nokia 7650 and from the bookmarked weather camera and digital thermometer frame that is located about one kilometer from house. Typically, I also check the skiing weather and webcam in suitable places.

These simple examples are definitely LBS, some even navigation and positioning. They are useful, funny, and create value for me, but they lack an earning logic (value capture) in the sense that no third party intermediary makes directly money from these services.

### **Hockey-stick curve and chasm**

In the three scenarios (page 12), I would expect *less linear*, more hockey-stick type of take-up patterns where the initial take-up is slow but – after the chasm and in the tornado phase – diffusion becomes fast. iMode breakthrough took only two years.

### **Bowling alley- recognizing initial customers**

The analysis and comparison of Japan, Europe and US is clever.

Customer base or potential can be segmented in several ways. Like a cake can be cut into slices in the traditional, vertical sectorial way, or by cutting a thin round slice horizontally. The point is how one identifies a large enough customer segment to cover the relatively large initial fixed cost of an information product. Microsoft’s Autoroute runs on laptops which are not

and will not become consumer items and definitely are not mobile in any sense but which already have a large user base, namely, all business people. By building a European (or an American) wide product Microsoft was able to leverage its large customer potential.

LBS contains local and global businesses. An example of a local service is a fell guide announced in autumn 2002. But local content (such as Finnish) providers lack the economies of scale. In bulk products without personalization and deep content they will find it difficult to compete against global information products where marginal cost is zero. For an analysis see Shapiro & Varian (1998) Information Rules.

### **Service innovation perspective**

Positioning services are both service and social innovations. Where do service innovations come from? Statistics say they come from *customers*, and to some extent from networks and user *communities*. The mapping between the technology vector  $t$  and the customer value or service vector  $v$  is  $v \gg t$  (ie.  $v$  is much bigger than  $t$ ). That is, a technology  $t$  has many latent uses  $v$  to be discovered only by users.

### **Communities as innovators**

Ilkka Tuomi (2002) has written a book on network-based innovation processes. Positioning services are *social innovations* driven by *communities* of users. The prerequisite is the availability of cheap and user-friendly technologies.

Technology or even service vendors may initially have a biased or even a complete wrong understanding of the usage of their technologies. As an example, take SMS. Tuomi also mentions radio and telephone. Tuomi defines a technology as *technology-in-use*. Communities invent new *meanings* for existing technologies. A single technology may have several meanings. Even a radical innovation may start slow and be gradual.

Community LBS may closely touch those basic low-level Maslowian needs that made AOL and then SMS a success, namely, dating. However, in NAVIFuture report, the experts predict that the time for user created or community applications will be 2008–2010 (page 45). This may be a too conservative estimate. Communities are gift economies that create meanings and sense for their members.

### **Positioning or navigation**

Throughout the report, the expression *positioning* services or technologies is used. This could be understood so that the essence in *navigation* or *location-based* services is technological positioning. As an example, consider maps, weather, traffic, or travel. In many cases the information is required when the user is not on the site, "there", but planning to there, for example, in an airplane, or on the road. Thus, in these cases, positioning becomes irrelevant.

Location-based services without positioning are widely available in the Internet. In some cases, the user can input the location (manual positioning). Dropping positioning out banalizes location-based services.

Some services are positioning-dependent. For example, tracking or location-broadcasting. In some services, positioning may not be important, for example, maps, finding places and services. In some services positioning may be or not be important, for example, in traffic (page 39).

### **Prime movers and market making**

On the first row of page 8, the report says that future *unfolds* itself. One could understand this so that the future already exists but is hidden, or tacit, and then gradually opens up like a flower. Rather than an emergence of an existing pattern – a biological metaphor – the future is *under perpetual construction*. There are identifiable *prime movers* who have the conscious capability to create the future in a *market making* process.

The report mentions teleoperators several times as key players. Rather than teleoperators, Nokia with a 40 % global market share could be *the* unique prime mover or market maker. The future of personal navigation or positioning is thus dependent on the product launches and marketing decisions of a single company, Nokia.

This also contradicts with the idea that services are the key. The key is the availability of location-aware mass-market consumer-electronics technology. The practical difference is that if an unfolded future exists, it can be explicated and forecasted (tacit to explicit) and then bought as a report from a market research company. But a future under perpetual construction requires more vigilance, and continuous attention and discussion.

IT bubble is mentioned several times. Strictly speaking, IT bubble was the Y2K investment. It was real money. The second bubble was the Internet bubble which was not real. This bubble was pure speculation. Instead, the use of the Internet is increasing all the time. The third bubble was the C or telecom bubble, in Europe, 3G and in the U.S., broadband. This bubble was a timing error.

### **Portals, multi-channel services and repurposing of content**

It seems strange that the experts have mentioned application-specific portals as the only way to gather services together (page 39). Rather, location-based services could be seen as parts in many types of portals. In travel sites, weather and maps are standard features together with web cams. For instance, traffic information is available from the portal of Tielaitos that can be bookmarked (the frame address) with a browser-equipped phone such as Nokia 7650. I use this service every day. The average response time over GPRS is 3–5 seconds.

Key words are *repurposing* and *multi-channel* services. Traditional location-based services – i.e. travel guides such as Lonely Planet, Frommer, or Fodor – do not disappear. Travel guides are an established genre of books. There is no hope that – for instance – teleoperators'

single-channel services could replace these brands. In contrast, existing travel guides could leverage their fixed costs on multiplicity of channels. Content brands rule, and there is less role reserved for teleoperators.

### **Billing and the frequency of usage**

My usage of Autoroute with a GPS-equipped laptop in summer 2002 lasted several hours a day. While driving, we in the car were following the map on screen, anticipating road turns and places. Thus, from a transactional point of view, there was an infinite number of transactions. Billing per transaction could be completely out of question.

This usage pattern represents downloaded maps. It requires a lot of device memory, in this case, one gigabyte. If there enough memory, the the map is easy to move to the device. I have several small maps even in 7650, but the limitation is the device memory (not yet memory card).

On page 48, it is estimated that an average user of LBS will be positioning once a week in 2005. And that professional drivers use LBS several times a day. Based on my experience, these estimates make little sense. They are a mental trap, because they represent transactional thinking, motivated more by “earning logic” and value capture than value creation and any customer need.

### **Value to market**

This concept takes into account the alternative ways – or competition – to get navigation services. What is the value in mobile positioning compared to paper maps available at reasonable price everywhere – or asking a native person (when you could even get some extra information and meet a new person)?

When driving to an unknown place, I type-in to [www.maporama.com](http://www.maporama.com) the address of the place. The whole process including zooming the map takes several minutes with the 7650. It is faster to find the map from a PC, and print it before leaving, or even call the firm I am visiting on the road and ask for guidance if needed.

Car navigation systems have voice recognition to overcome “the limitation of the thumb”.

### **Services**

The rhetoric of value-added services was understandable in the context of voice telephone services but does it make sense in other contexts? By definition, what is a “non-value added service”? Doesn't a service always create value?

It is a good remark that positioning is a component in services rather than a stand-alone service itself (summary, page 57).

The report estimates that 23 % of Finns are using LBS in 2005. If this does include Internet weather and traffic services, it may even be underestimated. MMS is an attempt to find



an earning logic for these free services. But the financial estimates are too ambitious. ARPU over 200 euros? Wishful thinking. In a gift economy user and community created content precedes earning logic.

Considering The Problem Mill (page 50), I think the key is a GPS-capable mass-market open mobile phone from Nokia. Given this kind of a device, it immediately sparks enormous grass-root and community-based application development effort.

And when the dust settles, we will have the Killer Apps.

## **Ethics**

The chapter on ethics is good. There is no other possibility than that the user owns his data and can disable positioning. Jeremy Rifkin in his book *The Age of Access* (2000) sketched a future where citizens earn money by allowing access to their lives. He wrote that every time somebody's data is used, he/she should get a royalty.

Of course prepaid anonymous services prevent positioning of those people who do not want tit. Such as criminals.

## **Summary**

There is an overemphasis on concepts such as "business model" and "earning logic". Maybe because sellers are interested and active in these new services and making their own scenarios.

It is worthwhile to glimpse at the history of Internet. Its early phases were user driven and community based. It was a communicative tool in gift economy. Then, in late 1990s, business people made an overstatement and overestimation of its potential as "new media". The same thing happened with SMS. It was first underestimated as a community tool. Then it was even more overestimated as a content delivery vehicle, or "mobile media". There was no interest in text-based "portals".

Internet is slowly returning to its roots. It *creates* high value for users. But there is less direct value capture. Few make directly money from it. Indirectly the benefits are visible in better processes, in improved relationships, and in the context of multi-channel services. Also, key words include repurposing content and multi-channel services instead of mere portals.

Data services (including LBS) are a new competitive space for operators. So far there has been remarkably little creative initiative. It is bad if the only impression left *still* is the creativity in innovating new billing methods. Where are visible, interesting, genuine service-innovations, activities that could be classified as lead market making, and not mere copying. Also, the transactional mindset is a trap that prevents or at least slows LBS take-up.

The page 57 is a good summary.

# APPENDIX 3

Questions in the three Delphi rounds

## FIRST DELPHI ROUND

### I. TECHNOLOGY

#### I.A. POSITIONING

1.1. In 2005, will positioning of the terminal device happen

- in the terminal device
- in a network server
- elsewhere (specify)

Motivate your answer.

1.2. How will positioning data be transmitted between terminal devices, positioning servers and added-value services in 2005?

1.3. What is the significance and status of the following positioning techniques in 2005?

- satellite positioning
- network-based positioning
- local/indoor positioning
- another way (specify)

Motivate your answer.

As for satellite positioning:

- GPS
- DGPS
- AGPS
- others (specify)

Motivate your answer for satellite positioning.

As for network-based positioning:

- CI
- CI+TA
- CI+Rx
- CI+TA+Rx
- TOA
- EOTD
- OTDOA-IPDL
- fingerprint
- others (specify)

Motivate your answer for network-based positioning.

As for local/indoor positioning:

- WLAN zone
- WLAN fingerprint
- Bluetooth zone
- GPS-pseudolites
- ultrasound
- infrared
- RF-tags
- others (specify)

Motivate your answer for local/indoor positioning.

1.4. What will be the accuracy of positioning in 2005 in:

- satellite positioning in open terrain
- satellite positioning in city centres
- satellite positioning indoors
- network-based positioning in countryside
- network-based positioning in urban areas
- network-based positioning in city centres
- local/indoor positioning

1.5. What will be the significance of location roaming in network-based positioning in 2005? Motivate.

1.6. What will be the status and significance of open interface standards in LBS in 2005? Motivate.

1.7. Mention 1--3 most significant problems in positioning technique in 2005.

## I.B. DATA TRANSFER

1.8. What will be the significance and status of the following data transfer methods in 2005?

- SMS
- GSMdata
- High-speed data
- Cell broadcasting
- GPRS
- EDGE
- UMTS
- WLAN
- Bluetooth
- others (specify)

Motivate.

1.9. What will be the significance and status of the following data formats in 2005?

- HTML
- cHTML
- WML
- SMIL
- XHTML
- XML
- SVG
- GML
- others (specify)

Motivate.

1.10. What protocols will services be based on in 2005?

- SMS
- MMS
- WAP
- WWW
- e-mail
- others (specify)

Motivate.

1.11. What will be the role of pull and push techniques in 2005?

1.12. Will applications be installed in mobile devices or will they be browsed from network servers in 2005?

1.13. How will applications and contents probably be transferred to mobile devices in 2005?

- by pre-installing in the factory
  - with PC from CD/DVD
  - with PC from the Internet
  - on device memory cards
  - wirelessly on infrared
  - wirelessly by Bluetooth
  - wirelessly over WLAN
  - wirelessly in GSMdata call
  - wirelessly over GPRS
  - wirelessly over UMTS
  - others (specify)
- Motivate.

1.14. Mention 1--3 most significant problems in data transfer in 2005.

### **I.C. TERMINAL DEVICES**

1.15. Will positioning of a mobile device in 2005 likely to be

- standard feature of the device
  - accessory for the device
  - standard service in mobile phone network
  - extra service in mobile phone network
  - Bluetooth service
  - WLAN service
  - others (specify)
- Motivate.

1.16. What will be the significance of different devices as navigators in 2005?

- car navigation device
- wrist watch/computer
- handheld/palm computer
- mobile phone

- microcomputer (laptop, home/office pc, public terminal)
  - digital TV set
  - others (specify)
- Motivate.

1.17. What will be the significance and status of the following operating systems in mobile terminal devices in 2005?

- Linux
  - PalmOS
  - Pocket PC (Windows 3.x)
  - Symbian OS (EPOC)
  - others (specify)
- Motivate.

1.18. What will be the significance of programming languages and with which languages will terminal device applications be written in 2005?

- C
  - C++
  - Java
  - Visual Basic
  - Visual J++
  - others (specify)
- Motivate.

1.19. What will be the significance of open standards and software interfaces based on them, and what interfaces will especially be needed in 2005?

1.20. What will the increase in processing power mean in mobile terminal devices by 2005?

1.21. What will the increase in memory capacity mean in mobile terminal devices by 2005?

1.22. What will be the significance and status of the following ways of human -- terminal device interaction in 2005?

- display
- keyboard
- mouse, cursor
- touch screen

--speaker, earpiece

--vibration

--others (specify)

Motivate.

1.23. What will the progress in display technology mean in mobile terminal devices by 2005?

1.24. What will be the significance of terminal device power consumption in 2005?

1.25. Mention 1--3 most significant problems in terminal devices in 2005.

1.26. What did You think about the questions in part I? What was not asked; on what questions concerning development of navigation technology would You like to get expert opinions?

## II. APPLICATIONS AND SERVICES

### II.A. FORMS OF SERVICE

2.1. What will be the status and significance of positioning in mobile services in 2005? Motivate.

2.2. What will be the significance of the accuracy of positioning for mobile services in 2005? Motivate.

2.3. What will be the status and significance of different types of services in 2005?

--search of places and services

--map services

--route guidance

--conditions information

--mobile games

--monitoring services, transmitting of location

--tracking objects and animals

--marketing services

--others (specify)

Motivate.

2.4. What will be the significance of positioning and the services mentioned above in different tasks in 2005?

- mobile work
  - personal business and delivery
  - hobbies and exercise
  - travel and culture
  - public transport
  - welfare services and unhindered movement
  - security
  - others (specify)
- Motivate.

2.5. Which branches will significantly apply positioning as well as possibilities of applications and services based on it in 2005?

- agriculture and forestry
  - industry
  - HEPAC maintenance
  - construction
  - commerce
  - accommodation and alimentation
  - transport and stocking
  - estate and business services
  - public administration and national defence
  - health care
  - others (specify)
- Motivate.

2.6. Where will the use of applications based on local/indoor positioning be significant in 2005?

- emporiums and department stores
  - traffic stations
  - fair and exhibition facilities
  - museums
  - theaters, sports halls and centers
  - educational institutes and libraries
  - hospitals and nursing homes
  - industrial premises and warehouses
  - others (specify)
- Motivate.



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## II.B. REVENUE GENERATION AND VALUE CHAIN

2.7. How much will be the average turnover of positioning and services based on it per user of mobile telephone or other mobile device in 2005?

2.8. How much would users be willing to pay for a suitable terminal device in 2005?

2.9. How much would users be willing to pay for services per year, provided the right services be suggested to them?

2.10. Who will pay for the terminal device in 2005: Customer/operator/employer/other?

2.11. Who will pay for the positioning in 2005: Customer/advertiser/employer/other?

2.12. What will be the pricing method of positioning and services in 2005: Per event/month/year/sponsored/other?

2.13. What are the proportions of price components of positioned services in 2005?

- data transfer
  - positioning
  - contents
  - terminal device
  - software
  - others (specify)
- Motivate.

2.14. Who will offer location based services in 2005?

- terminal device manufacturers
  - teleoperators
  - media corporations
  - brands, chains
  - firms specialised in services
  - others (specify)
- Motivate.

2.15. What will be the significance of middleware suppliers in value chain in 2005? Motivate.

2.16. What will be the significance of alliances in service supply in 2005? Motivate.

2.17. How will service supply be realized by 2005?

- horizontally
- vertically
- otherwise (specify)

Motivate.

2.18. To what extent has horizontal competition been realized in different layers of markets by 2005?

- terminal device
- software
- connection
- positioning service
- tracking service
- index service
- map service
- route guidance
- other competed service types (specify)

Motivate.

2.19. What is the market status of branch/task/environment specific, comprehensive vertical solutions ("turn-key") in 2005? Motivate.

2.20. What party or parties dominate the value network of LBS in 2005?

- terminal device manufacturers
- network infrastructure manufacturers
- positioning technology producers
- mobile operators
- software houses and application developers
- portal owners
- integrators of professional applications
- wholesale and retail chains
- content producers
- others (specify)

Motivate.

2.21. What is the mobile operator's status in the value chain of LBS in 2005? Motivate.

2.22. What is the terminal device manufacturer's status in the value chain of LBS in 2005? Motivate.

2.23. Will LBS appear integrated in portals or does the market have some other logic for stacking services in 2005?

2.24. Mention 1--3 most significant problems in LBS in 2005.

2.25. What did You think about the questions in part I? What was not asked; on what questions concerning development of applications and services would You like to get expert opinions?

### III. CULTURES OF USE

#### III.A. USERS AND CULTURES OF USE

3.1. Who will need positioning in 2005?

- consumers
  - professional users
  - adolescents
  - the middle-aged
  - seniors
  - men
  - women
  - others (specify)
- Motivate.

3.2. What kind of persons, groups and communities will use positioning and LBS in 2005.

3.3. Could or should positioning and LBS be developed also from the point of view of fundamental services belonging to everybody as well as from that of added-value services?

3.4. Will people use positioning and LBS more likely in their work or free time in 2005?

3.5. What is the role of different sectors and users in 2005?

- private companies
- public sector
- associations, communities
- others (specify)

Motivate.

3.6. What is the significance of the possibility of users producing positioned information themselves, such as maps, routes or positioned annotations for different needs in 2005?

3.7. Why is positioning utilized in 2005?

3.8. Assess different types of positioning applications according to their consumer potential in 2005.

- trekking and sports
- traffic and routes etc.
- monitoring, tracking and steering
- travel and guidance
- marketing
- adventure and games
- self-expression and communication
- others (specify)

Motivate.

3.9. Assess the significance of LBS in the following user classes named by Nokia. (See background memo.)

- trendsetters ...with the latest model
- the posers ... and likes to be noticed
- high flyers ... business heavy users
- social contact seekers

Motivate.

3.10. How many per cent will use positioning in 2005 in:

- Finland
- the Nordic countries
- Central Europe
- Southern Europe
- Japan

- United States
- elsewhere

3.11. How often the average service customer will use positioning in 2005?  
Motivate.

3.12. Mention 1--3 most significant problems or reasons decelerating, constraining or preventing the introduction of LBS in 2005.

### III.B. DIRECTIVES AND ETHICS

3.13. How are immaterial rights to be agreed upon between parties in 2005?

3.14. What kind of restrictions apply to positioning in 2005?

- tracing children/oldsters
- monitoring employees
- transmitting location to service provider
- positioning and monitoring customers
- others (specify)

Motivate.

3.15. What positioning rights do authorities have in 2005?

3.16. In what kind of situations or services should the operator be allowed to offer positioning of an individual subscriber?

3.17. How should users be informed of their being positioned in 2005?

3.18. How will families, workplaces and different communities agree upon the right to position other persons in 2005?

3.19. Should certain special groups be legally protected from being positioned in 2005?

3.20. Mention 1--3 most significant ethical problems in positioning and LBS in 2005.

3.21. What did You think about the questions in part I? What was not asked; on what questions concerning development of cultures of use would You like to get expert opinions?

## **SECOND DELPHI ROUND**

### **I. THE BIG PICTURE**

1. What factors do you consider signs of a breakthru in mobile positioning? What does a breakthru in mobile positioning mean? What are the key elements of a breakthru? In what year do you think mobile positioning will break thru?

2. Where will positioning markets be most developed in 2005? How will these markets differ in Japan, USA and Europe?

### **II. MOBILE INTERNET**

3. Will handheld computer and mobile phone remain separate devices communicating via e.g. Bluetooth or will they merge and how is positioning going to be actualized in this process?

4. What kind of applications, services and other ways of use based on visual communication utilising positioning in 2005?

### **III. USER INTERFACE**

5. What is the significance of voice/touch controlled user interface and the keyboard in 2005? What are the weaknesses and strengths of these user interfaces?

6. Where will the profile data of the users of mobile devices be stored, how are they handled and who controls them?

### **IV. POSITIONING**

7. Is GPS a standard feature in mobile devices in 2005?

8. What are the critical factors for the generalization of AGPS?

9. How will the realization of the Galileo project affect the markets?

10. What accuracy is sufficient in local/indoor positioning?

## V. MARKETS

11. In 2005, will users be interested primarily in commercially produced content or content produced by the users themselves (good restaurants, places for mushroom gathering, diving and bird-spotting etc.). Motivate.
12. What kind of automated applications may be born around positioning technology? (E.g. Message to your family when you come home.)
13. Should the public sector itself offer LBS? Would these services be chargeable?
14. Have positioning and LBS become daily routines (like SMS) in 2005? Motivate.
15. Who are primary actualizers of local guidance services?

## VI. DATA PROTECTION

16. Will data protection requirements of positioning have been taken into account in system standards in 2005? Will available products support these standards?
17. Authorities have unlimited rights to positioning in cases of emergency and rescue as well as serious crimes. Should the police have the option to get information of the users of all mobile phones in the vicinity of the crime scene?
18. What kinds of criminal uses could involve positioning; what kind of threats should we be prepared for?

## THIRD DELPHI ROUND

### I. EUROPEAN MARKETS

1. a) What problems must be solved by 2005 in earning logic and e.g. billing of positioning services?
  - b) Which parties have a possibility to solve the problems?

2. a) Are the data communication and contents of positioning services going to be priced separately in 2005?

b) Is a fixed monthly fee or a price per transmitted data units likely to be more common?

3. At the moment teleoperators and equipment manufacturers dominate the value chain of positioning markets. Which actors will be dominant in 2005? Is the situation going to change by 2010?

4. What would make positioning in Europe by 2005 reach the same level as in USA, is the situation going to remain the same or will we be passed by even Japan?

5. a) What is your estimation of the volume of positioning services in Europe in 2005 (in billions of euros)?

b) How many per cent is that of the total service volume of the telecommunication sector?

## II. TECHNOLOGY

6. a) Is the mobile telephone network going to offer AGPS service by 2005?

b) Will AGPS service be carried out by teleoperators or whom?

7. Users in the mass markets want to have simple, compatible equipment and services. What fundamental technological choices have to be made by 2005 in order to be able to create mass markets for LBS?

8. Smart clothing and other integrated technologies are still far-off future. Which user interface technologies will be significant in 2005?

9. Location roaming in network-based positioning is considered important. Its problem is the protection of privacy. For this reason or another, is satellite positioning going to be the dominant technology or at least delay the dissemination of network-based positioning?

## III. SERVICES AND APPLICATIONS

10. Maritime navigation services have already become stable. To what extent will the contents of widely-spread positioning services be standardised by 2005 (e.g. the use of guidance in an unfamiliar city)?



11. To prognosticate traffic jams, in addition to camera-based vehicle identification, positioning of mobile phones has already been tested. What is the significance of anonymous positioning in 2005?

12. Visual communication is thought to have a significant role. What additional value will positioning bring to visual communication in a) consumer use b) professional use?

13. On basis of the second Delphi round, there were no signals indicating integrated services utilizing local/indoor positioning in 2005. What might be the reason for this?

14. Which will be more popular in 2005: Applications loaded in terminal devices or services used over wireless network?'

15. Everyone's interested in what are the services worth bringing to markets. What are the characteristics of these services? And how to test the services for this?

#### **IV. CULTURES OF USE**

17. On the producing of what kind of additional value will services in 2005 be mostly based? (Put in order of importance: Economical or functional benefit; adventure; status; other. If other, specify.)

18. In what year will the users themselves start to significantly produce located content for the use of their own and others like in the Internet nowadays?

19. On what prerequisites will existing seniors, who have surrendered also computer- and net issues, adopt positioning in their lives by 2005?

#### **V. AUTHORITY NORMS AND ETHICS**

20. Estimate the significance of different kinds of possible misusers of positioning in 2005: Crackers; professional criminals; Authorities; System operators; Others. If others, specify.

21. What in applying of positioning will be affected by 2005 and how by differences in legislation between European countries? (E.g. earning logic, standardising, data security?)

22. What is by definition the location information of an individual person in 2005?

23. a) What would be the most suitable way of protecting a person's location information?

b) In addition to legislation, will contracts on positioning between parties be needed in 2005?

24. Should positioning information be used for crime investigation in 2005, by what procedure should they be passed on to authorities?

## VI. METAQUESTIONS

25. In addition to this and earlier Delphi rounds, what changes in trends shaping the future of personal navigation have you noticed during this year? Where do you think they will develop by 2005?

26. What more should have been asked in this third Delphi round? What would you have answered?

27. When will results from NAVIfuture expire?

28. Have you learned something from this process? Have the two earlier rounds brought anything useful to you so far?

29. What are your wishes concerning the final report? (E.g. volume, form, purpose?)





(YOU ARE HERE.)

