

Location aware applications take off



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Executive summary

Mobile terminals and wireless networks offer subscribers one distinctive benefit that fixed networks cannot: mobility. With mobility, location becomes a critical attribute that can be used by everyone involved in the wireless value chain.

Nokia's view is that location aware applications are about to take off, thanks to growing awareness among consumers, open software platforms and the successful opening up of the telecommunications business itself. Smarter mobile terminals and the success of GPS positioning technology will also have a major role to play.

Consumers are becoming more aware that their mobile phones are actually small computers, capable of helping them in many useful ways. New application areas such as interactive navigation, community services, location aware information and location aware gaming are particularly important in making the most of the mobile advantage.

Ease of use, personalization and focus on the needs of the consumer are also crucial elements in the success of location aware applications, as is the availability of a variety of technologies such as GPS, GPRS, HTML browsing and MMS.

The mobile industry, until recently dominated by telephony applications, is seeing an increase in the use of data, bringing added importance to developers of these consumer applications. Developers themselves have more choices in both architecture as well as the distribution channel. To help them, Nokia is implementing an open, location aware software platform, which developers can use to compete in the consumer applications market.

This will allow Symbian and Java™ developers creating location aware applications for the Series 40 and 60 software platforms and in all the UI styles to focus on developing instead of trying to fully understand positioning technologies. The applications available in today's high end-terminals will be available in volume terminals tomorrow.

A variety of different types of applications are needed to provide the best experience for users as well as the best revenue possibilities for operators. Nokia sees location aware applications shifting from being mainly network server based applications to client-server applications, with interactive navigation leading the way.

Attractive market opportunity

In recent years, location based services received a lot of attention, making them a promise which has taken more time to materialize than expected. Strategy Analytics (March 2003) estimates that in 2008, location enabled services will generate over \$8 billion in global service revenues.

Analysts have examined various reasons for the slow market take off, such as high-entry costs for 3G-networks, general economic decline and fragmented e2e technologies. Other factors have been the lack of an open centric business ecosystem centered on developers and applications – so far, the telecoms domain has been characterized as a standards driven environment, monopolized by carriers and terminal/infrastructure manufacturers.

The mobile location services market consists of consumer applications market, software platform market, and positioning technologies market, which all require both terminal and server location technologies. Nokia is active in all of these markets.

It has been estimated that today, more than 60% of operator revenue still comes from voice calls, yet the number of profitable data services is growing rapidly. One could even say that it is not about transporting 'bits' as such, but rather 'value adding application bits'. Today, the penetration of mobile phones in a number of countries is well over the 50% mark – in fact, growth in the mobile phone market is already made up to a large extent of terminal replacements and therefore, there is a vital need to differentiate through services in order to capture these replacement purchases.

Services will also be a key asset in the battle for customer loyalty. When saturation point is reached in mobile markets, operators will be looking at ways to retain their customers, and issues such as cost, quality, and service differentiation will become of paramount importance. Location aware client-server applications could very well provide another solid revenue stream.

Retrospectively, we can now say that when the hype was at its highest a few years ago, all the factors that currently influence location aware service markets did not exist. These drivers, which will lead to a great boost in the location aware applications market, are: positive consumer awareness, the success of an open business ecosystem and open software platforms, the success of smarter mobile terminals, and the success of GPS positioning technology backed up by Cell ID positioning.

Positive consumer attitude to location aware services

A recent consumer study by Nokia looking at consumer attitudes showed that consumers are positive about location aware services. The study, which covered Europe, APAC and the Americas, showed that GPS was the most appealing application. Clearly, consumers are more aware now of the possible services available and are starting to weight quality and usefulness over novelty and technology itself. Moreover, consumer focus is on using GPS for urban/suburban everyday living rather than occasionally on pure outdoor or sporting usage. There was some interest in the basic GPS function of showing position, but more enthusiasm was shown about value added services such as directions and yellow pages.

In the study, GPS or location services were often even spontaneously suggested as a function that consumers would want on their phone. It was seen to meet a basic human need – “where am I in my world, what is around me”. It was also suggested that, to make life easier, these functions need to be integrated into the one product that people nearly always carries with them – the mobile phone.

Consumer behavior is obviously driving the development of applications and services. Therefore, the key to commercial success lies in understanding the consumers, their lifestyles and attitudes, and creating the product-service combinations that match their expectations and needs. Most importantly, the services and applications need to be intuitively user friendly, fluent and safe to use. Those who deliver winning product categories and platforms with the right technologies will succeed.

Success of open software platforms and the business ecosystem

Developers of location aware applications are the key the take off of the market. By writing consumer applications for Symbian and Java platforms using Series 40, Series 60 and Series 90 user interface styles, they can reach the largest and fastest growing consumer base. Currently, the Series 60 is licensed to five mobile terminal manufacturers, representing a significant overall market share. From this group of five, Nokia already expects to be shipping 100 million terminals based on Series 40 and Series 60 platforms having color displays, Java and MMS in 2004.

Symbian terminals are based on a dominant smartphone software platform, with total volumes exceeding those of Palm and others combined (ARC Chart Nov 2003, see Figure 1). For example, a report in 2003 from Canals estimates that phones based on Symbian OS accounted for 94% of all feature phones and smart phones in the EMEA region in Q2, 2003.

On Series 60, Merrill Lynch stated in February 2003: “On handsets, we believe that Nokia’s Series 60 Platform has gained significant momentum both in terms of licensees as well as applications development. With more Series 60 devices expected to launch in 2003 and beyond, we believe that it is likely to become the standard smart phone platform.”

Java will be enabled globally in almost all new mobile terminals. It is a good choice, especially for those developers who are turning away from lower-end-terminals towards smarter terminals and have an established brand as a Java developer.

Consumers may choose from a variety of location aware applications. Moreover, developers create software on the platform they choose and can also choose from several delivery channels, for example, operator XSP or Nokia software market. All this constitutes to the creation of open business ecosystem with plenty of product offering and less technical constraints.

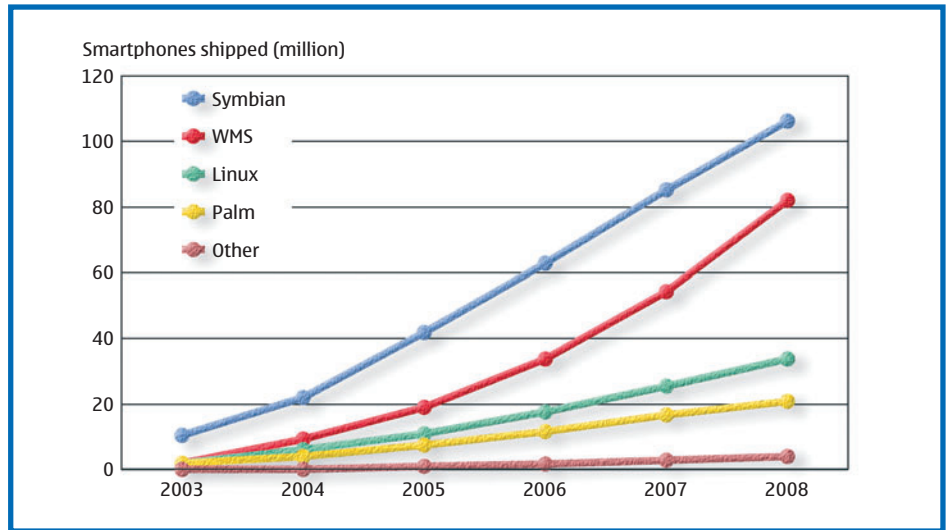


Figure 1. Symbian terminals constitute the biggest and fastest growing segment (figure showing cumulative growth) in the category of smart phones and PDAs. Source: ARC Chart Nov 2003.

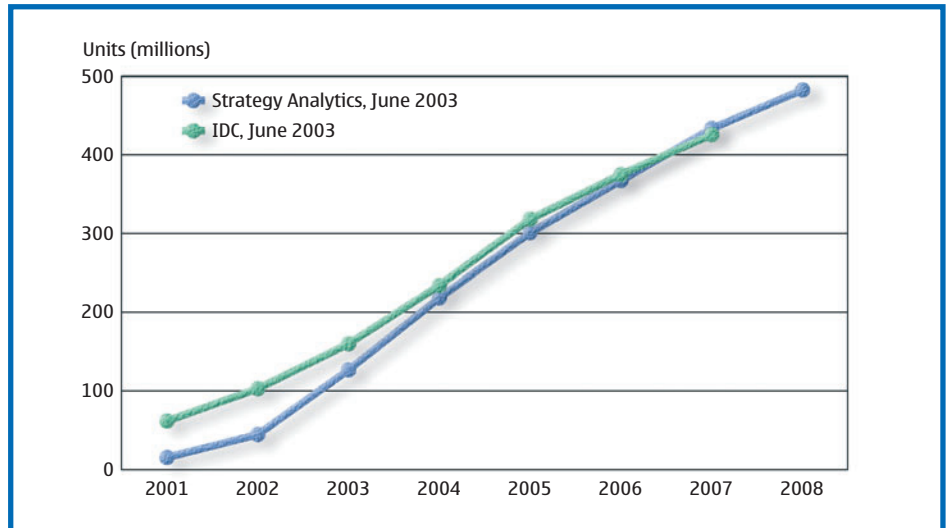


Figure 2. Java terminals quickly constitute a lucrative base for Java consumer applications business, figure showing cumulative growth. Source: Strategy analytics June 2003, IDC June 2003.

Success of smart phones

What is today's high range is tomorrow's mid-range – in upcoming years, terminals on the Series 60 Platform will be available for a wider consumer market, thus making the consumer applications market even more lucrative. This is illustrated in Figure 3. Today a mobile phone can do much more than in the past. Technological advances, with bigger color displays, XHTML browsers, faster and safer connections (GPRS, EGPRS, TSL/SSL) and more intuitive graphical user-interfaces, have aided the development of the market by making mobile services much more appealing.

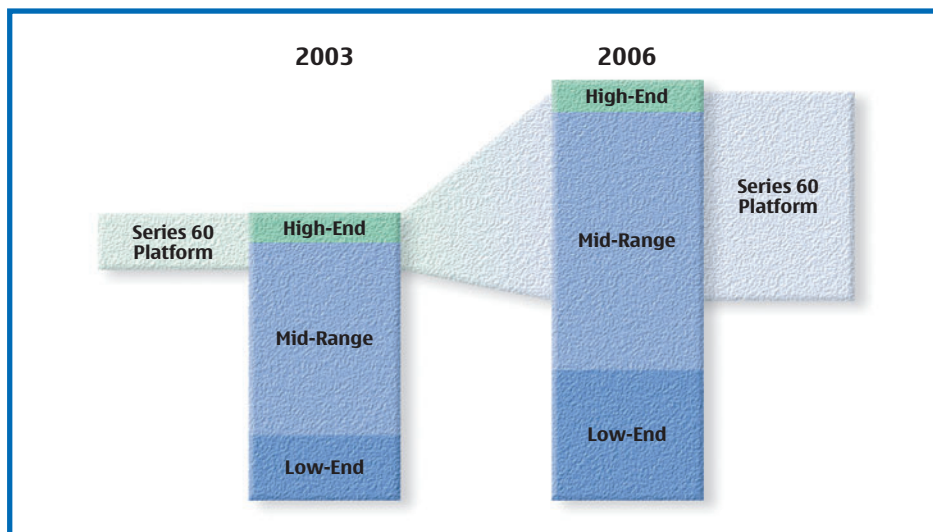


Figure 3. Series 60 Platform will soon address the midrange terminal market. Source: Nokia.

Success of GPS and Cell-ID positioning technologies

Regulation is one of the strongest drivers of mobile location services. US legislation requires that all mobiles sold in the US can be positioned in case of emergency. The US FCC mandates for E-911 services, as well as the equivalent European Union requirements for E-112, have a big impact on the positioning technology adopted by mobile network operators. This E911-requirement is a boost to the location aware applications market, especially in CDMA, where GPS positioning technology has been selected. Already during 2003, all CDMA mobiles need to be GPS capable. The market is notable in that 110 million CDMA terminals are predicted to be sold during 2004, rising to 127 million in 2006. (Source Credit Suisse First Boston August 2003).

In Europe and Asia, the GPS expansion will follow a slightly slower path, paved by the emerging GPS accessory market and used particularly in personal navigation and mobile entertainment. Operator networks mostly provide support for cell based positioning and are gradually building support for A-GPS. The cell ID based positioning will be the main positioning method in most sold terminals for quite a long time to come. Terminals will be able to utilize the network provided coordinates calculated with cell ID methods when available from the network.

Location aware applications and services

Definition of mobile location system

The terms location, location based services etc., can be seen from several viewpoints. Here is a definition for the mobile location systems as seen in the context of this paper:

“Business and technology ecosystem, which enables business based on the actual, said or intended location of a person or object.”

The business system comprises the value network of companies providing location related commodities: production resources and consumer products.

The technology system comprises of enabling delivery platforms – mobile network + terminals + e2e platform software + positioning + electronic market hardware & software.

Moreover, in this paper we talk about location awareness – applications are not location centric, but instead, the positioning information is used to add value ingredient to a wide range of applications and services. For example, an ordinary tourist information service that tells you the price of fuel in a country does not deliver the best value, but a service that directs you to the cheapest petrol station near your location does.

Many existing information services can be enhanced by proper use of an e2e software platform. In Japan, most operators do not charge extra for the location element, choosing instead to enjoy the increased usage and hence maximized revenue streams from customers who are attracted by the ease of use of location-enabled applications. Fleet management or group management applications can be developed on top of tracking services. Group management (locating your friends, family, etc.) applications will be successful in countries with high SMS penetration, because operators can take advantage of the fact that SMS is in wide spread use and is familiar to customers.

Example of usage possibilities

Panel 1 (Top Left): Daniel Newmark is getting ready to leave for work in the morning. He uses his mobile terminal for a quick check of the local weather forecast.
 *Caption: Daniel Newmark is getting ready to leave for work in the morning. He uses his mobile terminal for a quick check of the local weather forecast.
 *Thought bubble: Seems to be fine day but in case of the heavy rain better grab umbrella with...

Panel 2 (Top Right): Having just sat in the car, his personal navigation system prompts verbally that there has been an accident on his normal route to work.
 *Caption: Having just sat in the car, his personal navigation system prompts verbally that there has been an accident on his normal route to work.
 *Alert: ALERT, ACCIDENT ON ROUTE 8. ALTERNATIVE ROUTE...
 *Thought bubble: This service is great! I just avoided a 8-mile tailback with the alternative route!

Panel 3 (Bottom Left): On his way his calendar reminds him to take his car for a scheduled service to a garage near by his office.
 *Caption: On his way his calendar reminds him to take his car for a scheduled service to a garage near by his office.
 *Alert: REMINDER: SCHEDULED CAR SERVICE AT JAKE'S GARAGE

Panel 4 (Bottom Right): Upon the arrival at work, his mobile web browser automatically shows him the news headlines from the site he has linked to this location.
 *Caption: Upon the arrival at work, his mobile web browser automatically shows him the news headlines from the site he has linked to this location.
 *Thought bubble: Ok. Here's my daily update on the local news.
 *Screen: WWW.NEWS.COM Today's headlines 12.6.2004 DOMESTIC NEWS Minister for Foreign Affairs vetoes against Hurricane strikes

Panel 1 (Top Left): Daniel remembers he should make a reservation to a squash court for him and his mate Mike.
 *Caption: Daniel remembers he should make a reservation to a squash court for him and his mate Mike.
 *Thought bubble: I'll send the location details of the center as waypoint information to Mike's terminal. Now he'll know where to come even with a short notice.
 *Screen: MESSAGING To: Mike Miles Subject: New squash hall Hi, remember tomorrow 11.6 at 17 pm. Daniel

Panel 2 (Top Right): Next Daniel should pick up his wife Jane.
 *Caption: Next Daniel should pick up his wife Jane.
 *Thought bubble: Ok. He'll be here very soon. It is good that we have both given access rights to our location information. Otherwise I would always have to worry about Daniel...
 *Screen: AREA MAP DANIEL'S LOCATION

Panel 3 (Bottom Left): After a while they meet.
 *Caption: After a while they meet.
 *Thought bubble: Honey, we'll have to take the subway back home. My car is still at Jake's garage.
 *Thought bubble: No problem, just remember we have to find a birthday present for Tim's & Karen's son...
 *Screen: SEARCH RESULT FROM 17.0515 HOURS

Panel 4 (Bottom Right): In the subway they see some enthusiastic teenagers playing the latest location aware "Spot the spies" -game with their Bluetooth enabled mobile gaming consoles.
 *Caption: In the subway they see some enthusiastic teenagers playing the latest location aware "Spot the spies" -game with their Bluetooth enabled mobile gaming consoles.
 *Thought bubble: Look honey, that solves our problem. I am sure that Ethan would love that game...

Had they decided to walk around and try to find the closest station nearby by themselves, they might have gotten lost in the somewhat strange neighborhood. Furthermore, in the worst case they could have wandered into some dark and uninviting area. Had this been the case,

Daniel would most likely have felt for his mobile terminal in his pocket and know that by calling to the emergency center they could be located easily and sent immediate help if needed. Thankfully, they could rely on the location aware services to aid them safely home.

Value of mobile location systems to consumers

Services that can use location information can be grouped, for instance, as illustrated in Figure 4.

Location aware applications and services stand out because they provide the consumer with:

- Enhanced personal navigation and route finding. For instance, by listening to the turn-by-turn directions on how to get to the party.
- Enhanced personal communication when using e-mail or MMS: For example, the user can receive a picture with attached location as an invitation to a house-warming party.
- Location aware personalized information, e.g. “where are the nearest restaurants?” This can be done with no need to enter the current address or city district information, making the service faster and easy to use.
- Location aware games and entertainment, e.g. “catch the enemy spies around you while taking the bus to school”.
- Increased safety, e.g. locating lost hikers.
- Professional tracking services e.g. operate a fleet of trucks and optimize usage knowing where they are.

From these services, Nokia estimates that navigation, community and location based information services have the biggest business potential in the consumer market in 2003–2004.

Ensuring privacy

From the users’ point of view, there could be a threat that someone could be using his location information without an agreement and for unknown purposes. Here the matter of user control over location information becomes crucial. A viable solution is that the user can manage the access rights to his location information himself from the terminal UI.

User’s privacy settings are always checked before any application will use the terminal’s location information.

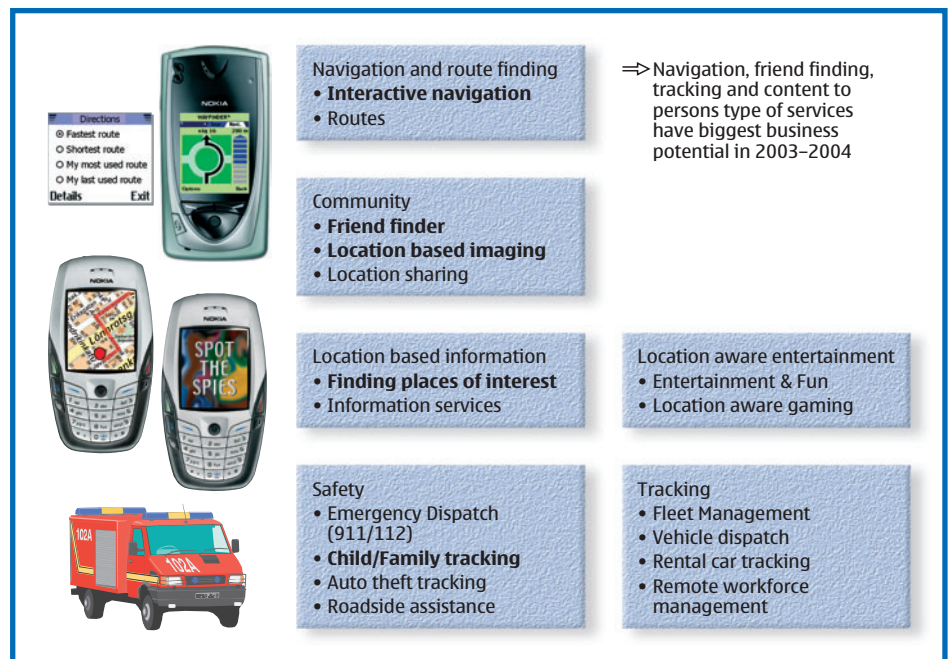


Figure 4. Location application/service categories. Source: Nokia.

These terminal privacy settings can be predefined or set on the fly when a new service is requesting them, naturally always matching the user’s wishes. With this checking method the possibility to misuse such private information is effectively removed.

Nokia mPosition iGMLC provides a privacy manager for checking user privacy when server side application requests location from network. Moreover, 3GPP standardized LCS MT-LR privacy verification and notification support is implemented in GSM/WDCMA phones.

Business models and value propositions in location application take off

Business models

The success of location aware applications will be aided by simple and effective business models, which are summarized in Figure 5.

When looking at the business models from the consumer’s point of view, we can divide the model into three key events: 1) the model used when the user purchases the location aware consumer product. 2) the model when the consumer product is in use and 3) the model for the next purchase.

Simple and convenient purchasing of a complete, out-of-the-box functioning product, in a ‘one-stop-shopping’ experience with few invoices, is the overall target of these models.

The value chain of location aware products can be divided into the following ‘roles’: Consumer, electronic market/physical retail store (the place where the product is bought from), service provider (to brand and run the service), network operator (provider of mobile network connectivity), mobile phone vendor (provider of mobile

terminals), GPS technology vendor, network positioning vendor, map provider and developer (vendor and coder of client-server application). Depending on the corporate strategy, each actual company can be active in many of these roles, or in none of them. For example, an operator can be a network operator, a service provider and an electronic market.

During a first time purchase, the consumer gets the complete location offer (terminal + platform software + positioning + data access + consumer application) as an easy offer. The money he used to purchase the location solution is further divided amongst the players further down the value chain.

The consumer may use the application for free, if he already paid for the application or if the application is a form of advertising financed by corporates. If the positioning is network based, some positioning costs during usage may occur. With client-server applications, bits are consumed and bit-costs occur. At the next purchase, the consumer wants to use new applications with his platform, and so he simply purchases new items from an electronic market or from a physical retail store.

Value propositions for stakeholders

This new market for open location aware applications market and e2e technologies brings new benefits and business opportunities for everyone in the value chain:

Consumer

Get new, suitably priced aids to manage their life, through a large number of innovative, location aware applications, suited to a variety of consumer tastes and needs.

Electronic market / physical retail stores

Benefit from a growing retail application business, both through physical retail and electronic delivery.

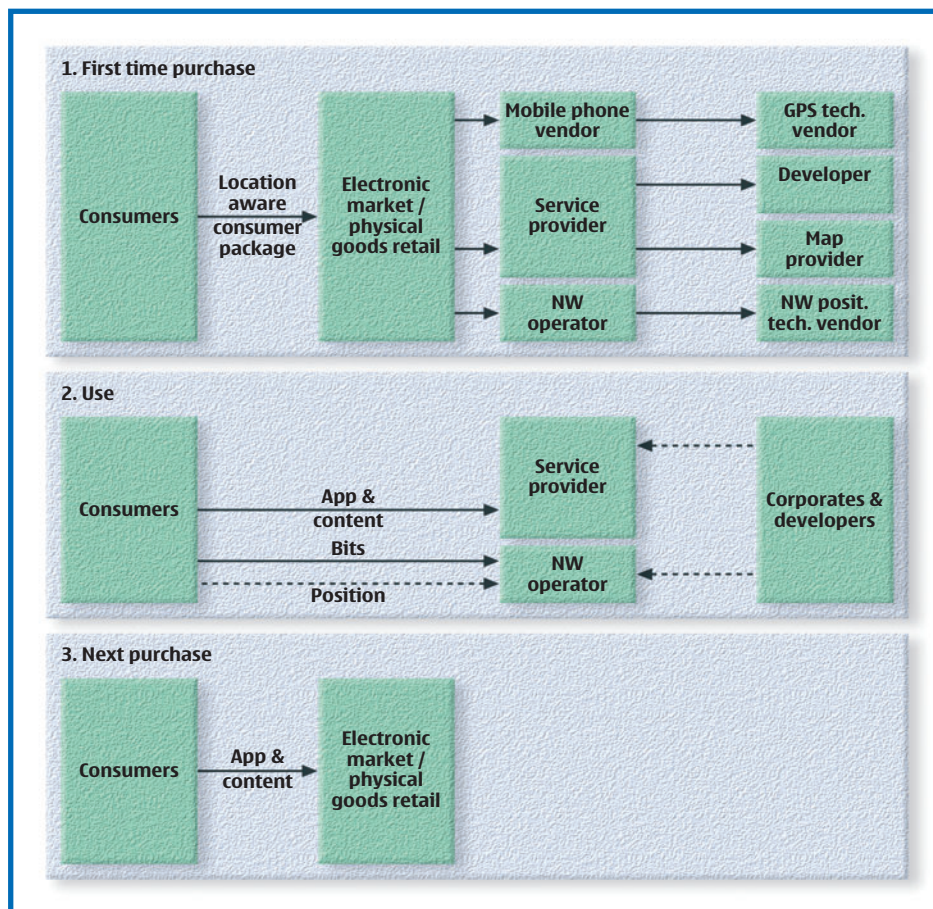


Figure 5. Business models in location applications take off. Source: Nokia.

Service provider

Benefit from running a specifically tailored portfolio of location aware applications, tailored and selected according to the service provider in question. Additionally, they could use the mobile channel to promote a brand to those customers who agree to receive such information.

Developer

Get convenient access to the huge mobile market by implementing software products for a global platform.

Network operator

Enjoy growing bit-volumes and bit-revenues brought by a growing number of location aware client-server consumer applications. Benefit from additional revenues in mobile billing.

Mobile phone manufacturer

Gain differentiation advantages via a multitude of location aware applications running on open software platforms and highly penetrated positioning systems, GPS being the most accurate one.

GPS technology manufacturer

Benefit through a greater demand for GPS technology, driven by the consumer demand for applications.

Network positioning technology vendor

Complement GPS technology penetration with a less accurate positioning system that can also be used with non-GPS terminals.

Corporate

Achieve enhanced brand visibility.

Architecture and technologies

Location end-to-end service architecture

The location end-to-end architecture consists of three layers: consumer applications, platform software and positioning technologies, as illustrated in Figure 6. Implementations in all of these levels need to be achieved for location applications to take off. Each one of these layers can be implemented in both the mobile terminal and in network infrastructure.

Currently, the situation regarding the variations in location service architecture is as presented in Table 1.

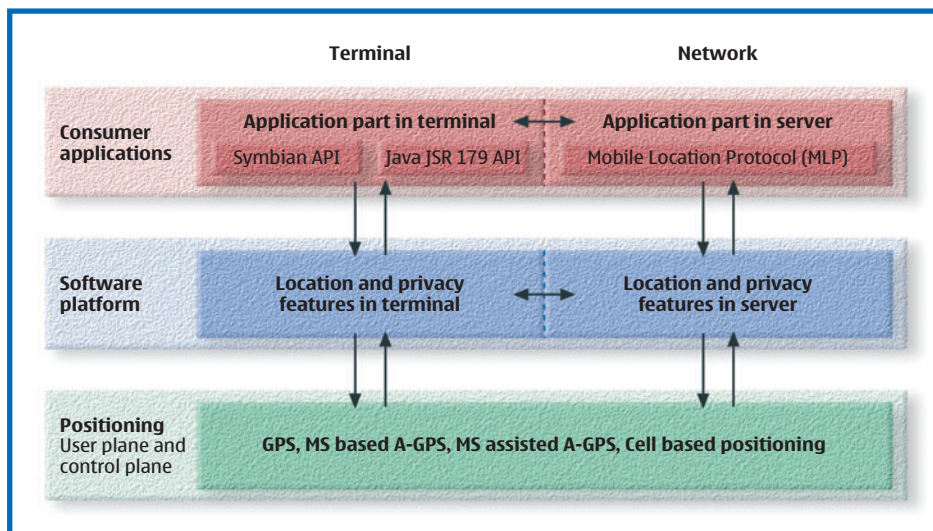


Figure 6. Location end-to-end architecture consists of three layers.

Table 1. Service architecture status chart.

Service architecture	Current situation
Terminal preinstalled and 3rd party applications	<p>Ramping up, due to growing number of Series 60 terminals, GPS and CI -terminals and growing penetration of MO-LR.</p> <p>User may use preinstalled location enhanced applications in the terminal.</p> <p>User may also install additional location applications to the terminal.</p> <p>Position is fetched by terminal SW platform either from terminal positioning or from network location server.</p>
Application execution is distributed to both terminal and server	<p>Exists now. A smart phone uses either terminal Symbian location API or Java location API (JSR-179) in a thick terminal resident application, which may also have a server part running over data connection. Server part may utilize Mobile location protocol.</p> <p>This is a hybrid model.</p> <p>Terminal part of application provides mainly UI and some processing, while server part takes care of the rest of the transaction processing.</p> <p>Note that: Also server side application may provide the UI and user service.</p> <p>Position is requested either by server part of application or terminal part of application from corresponding SW platform.</p>
Applications run on server side	<p>Exists widely now.</p> <p>User may access the services with browser.</p> <p>Applications request position from server SW platform (network location server). The server SW platform may request the position from network positioning or from the terminal SW platform.</p>

Consumer applications and location content

Nokia sees that all kinds of applications will be needed. Terminal applications are Symbian or Java applications, which are run in the terminal. Data and content are either in the terminal application or can be fetched from locally available removable media, such as the Multi Media Card (MMC). Server applications are integrated to web services and viewed with a browser in the terminal. Client-server applications have both the terminal and server part, which are linked together by an application-specific protocol, often via GPRS or analogue data bearer.

Content in location applications is typically map- and point-of-interest data and additionally some dynamic, place and time dependent information such as weather or traffic information. Also, content can be in terminal, in server or a mixture in both terminal and server.

Consumer applications use open and standardized developer APIs to request positioning. Symbian location API and Java JSR-179 API are the key application interfaces in terminal- and in client-server applications. OMA MLP to GMLC is used by server applications.

Platform software

The most important benefit of the location aware software platform is that the APIs used are positioning technology agnostic, i.e. applications do not need to care about the technical differences between various positioning technologies. However, when using the native API, it is possible for the applications to get information on what positioning technologies are available in the device. This way the software platform allows the developer to concentrate on creating consumer applications instead of trying to understand the various positioning technologies. Consumers probably do not even know about the location aware software platform, but simply enjoy the growing number and quality of location aware applications.

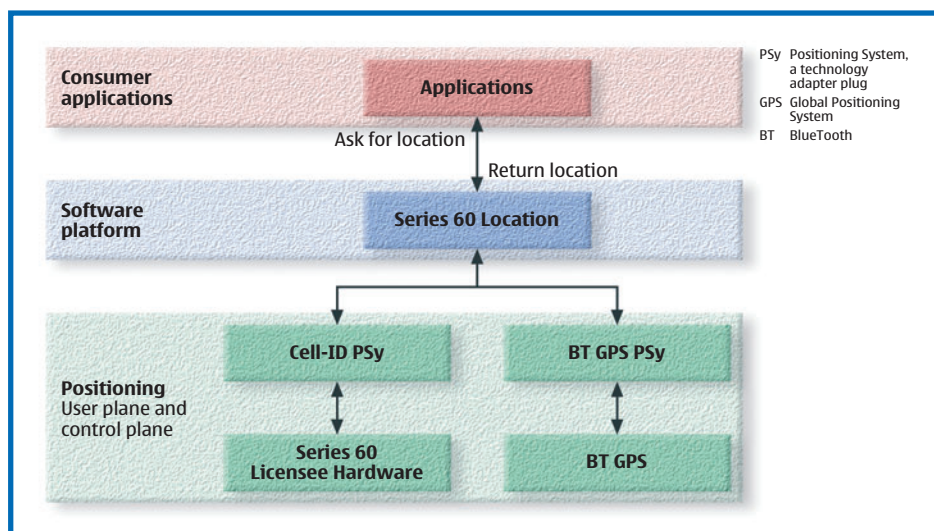


Figure 7. Location in Series 60.

Platform software in terminal

Nokia terminals supporting location aware services come in three different user interface (UI) styles: Series 40, Series 60 and Series 80. In a way similar to the consumer application layer, terminal software can use both Java and Native Symbian application development platforms, as well as the open and standardized developer APIs for acquiring location related information.

Nokia's Series 60 software is location aware, meaning that applications can use the positioning framework of Series 60. Currently, this is done using any Series 60 terminal, Bluetooth serial profile, standard NMEA and external Bluetooth GPS. Also in the near future, the GPS functionality will also be available as an integrated part of the terminal. To conclude, we can say that with Series 60 the main features regarding location are:

- Abstracts actual positioning technologies from applications
- Allows different positioning technologies as plug-ins
- Offers the user centralized management of technology and access control.

Java applications

Java, and in particular the J2ME™ Mobile Information Device Profile (MIDP), is a common interoperable application

platform supported by most mobile phones on the market today. MIDP Java applications are supported by both Nokia Series 40 as well as Series 60 terminals, allowing application developers to target the widest potential customer base easily.

Within the Java Community Process, an application programming interface for location aware applications, the JSR-179 Location API for J2ME has recently completed the standardization process, allowing Java applications to obtain the location of the terminal.

This API is designed to work with any positioning technology, including GPS as well as Cell-ID technologies, provided that the terminal is able to retrieve the location information from the network. The applications access the location information in a generic way without needing to know the differences between positioning technologies. This ensures that the same application can work across all terminals and all positioning methods while still getting access to all relevant information.

In addition to being able to provide the location information to Java applications, the API also enables applications to access a database of landmarks stored in the terminal. If the terminal has compass or orientation sensors, the application can also access these via the API.

The JSR-179 Location API, which will be supported by Nokia terminals in the future, allows the development of new location aware applications and services using MIDP Java applications, as well as allowing the easy addition of location awareness to existing MIDP Java applications in the market.

Platform software in network

The Nokia mPosition Solution provides operators with a standards-based location server middleware and network based positioning solution. The basic elements of mPosition are the Serving Mobile Location Center (SMLC) and intelligent Gateway Mobile Location Center (iGMLC), which hides network positioning technologies from applications and provides enhanced privacy, security, roaming and profiling functionality.

Positioning technologies

Positioning may be initiated by the subscriber, the network or an external application. Among the entities that will use this capability are government agencies (e.g. locating emergency calls), mobile operators (e.g. home/office zone applications and network planning applications) and third-party service providers (e.g. electronic yellow pages for nearby services and “where am I” applications).

Nokia supports both terminal and server centric positioning technologies.

Positioning technologies in terminal

In terminal centric positioning, all variations of GPS are supported – standalone GPS, Mobile Station Based A-GPS, Mobile Station Assisted A-GPS and overlay A-GPS. A mobile phone equipped with a GPS receiver can work either in a stand-alone mode or in one of several assisted (A-GPS) modes. The A-GPS modes differ according to the cellular data channel used to transmit assistance information and according to whether the position is calculated in the network or in the terminal itself.

Stand-alone GPS is perhaps best known to the consumer electronics market from hand-held positioning receivers. The primary positioning function relies entirely on GPS satellite signals and a cellular connection is not necessary unless it is needed for services. Stand-alone GPS typically works well in outdoor areas but it lacks the high sensitivity required for indoor operation.

Assisted GPS uses the cellular network to get extra information that helps it work in indoor areas or where the satellite signals are too weak to be received by a stand-alone receiver. The auxiliary information can be a part of a user accessible data transmission (user domain assistance) or a part of a system internal control message (control domain assistance). Control domain assistance is specified as an optional feature in cellular standards, while user domain assistance is yet to be standardized. It is generally understood that user domain assistance will be encapsulated in IP packets, and so is also known as IP overlay assistance.

The components of complete GPS assistance are satellite orbit information, time, and coarse initial position. In some cases there is also information about satellite signal code phase and Doppler frequency. The accuracy of the assistance components may vary between cellular systems and individual networks, a higher accuracy generally leading to higher sensitivity and faster receiver initialization time.

Assisted GPS positioning consists of three main steps. First, the receiver acquires satellite signals and measures their propagation delays. Depending on conditions, it may need to use assistance information before the acquisition can be completed. Secondly, satellite orbit information is received, either directly from the satellites or as a part of the assistance information. Thirdly, receiver position is calculated from the measurements and from the satellite orbit information. The third step can be alternatively conducted in the receiver or in the network and is called either Mobile Station Based or Mobile Station

Assisted AGPS, respectively. Mobile Station Based operation modes generally offer more application flexibility and demand less network capacity than Mobile Station Assisted modes.

Positioning technologies in network

The Nokia mPosition Solution supports several network based positioning methods, from cell accuracy (CI) to enhanced CI (TA + RX) and, in the future, to high accuracy Assisted GPS (A-GPS), with the flexibility to base investments on the applications offered by the operator. With these multiple location methods, operators can support all mobile terminals and users, generating more revenue, reducing costs and guaranteeing a future-proof solution. Furthermore, the operators not only benefit from better location accuracy, but also from improved network synchronization and increased capacity from the existing network in the future.

Nokia's network based positioning system can support different location methods for different radio access networks; GSM/EDGE and WCDMA, as well as circuit and packet core networks. It can be upgraded to meet the accuracy needs of more enhanced systems. It can also be scaled to meet the needs of an increased user base, as well as to support a high availability platform.

In GSM, the Cell ID location based method relies on the identity of the serving cell to estimate the handset's co-ordinates and works with legacy phones. This method is very cost-effective and does not require configuration changes in the radio network. In WCDMA, the Service Area Identifier (SAI) based location method relies on the identity of the serving area to estimate the handset's co-ordinates.

In GSM, enhanced Cell-ID accuracy can be achieved using the Cell Identifier (CI), Timing Advance (TA), and Received Signal level (Rx) method or several combinations of these. In WCDMA, improved accuracy can be achieved using the CI + Round-Trip-Time (RTT) method.

High-level accuracy is achieved with the A-GPS system in both GSM/DGE and WCDMA, which requires mobile terminals supporting A-GPS. The mobile terminal itself performs the position calculation, whereas the network provides assistance for positioning. An additional element for A-GPS is the Location Measurement Unit (LMU).

The location methods are standards based – they will meet the challenges of mobile location services in multi-vendor networks and offer roaming support. Less integration is required and application/service development for the API is easier, making more services available.

The same network based location system solution can address the needs of emergency service callers (E911, E112), commercial location-based services and operator services. The system offers an interface for both internal and external servers as well as for commercial applications.

Developer tools

Nokia supports open software development tools, which enable development of the applications in service architectures.

Nokia's Developer Platform approach is designed to help developers build and deliver mobile applications to a global audience in less time, with less effort and cost. Developers can build core functionality on top of the platform technologies, and then optimize their applications for specific user interfaces and technology extensions for target devices.

The Symbian location API will be available for Series 60 and Series 90. The Location API for J2ME (JAVA JSR179) will be available for all Nokia UI styles.

From Forum Nokia, there is also available a Java software development kit (SDK) that implements MLP 3.0, making it ideal for server software developers when developing location applications.

The developer platform will also be launched for CDMA, giving developers working with CDMA better tools and support. Yet, there are some challenges due to the fact that there is no common technology, as operators have chosen different technologies and there are a number of terminal types.

Nokia is committed to standards and open platforms

Location aware services allow mobile users to receive services based on their geographic position. There are a number of software platform and positioning systems in use throughout the world today. A problem for a wider adoption of location applications is the fact that these systems lack interoperability. Given the variety of systems available, standards are necessary to ensure seamless service roaming and to provide a platform for developing open system architectures capable of interfacing with a variety of application protocols and positioning technologies.

Open Mobile Alliance (OMA) has been set up with the objective of creating the industry consensus necessary to implement an interoperable, standards-compliant technology and solution roadmap that includes location services.

Location is standardized in various organizations and fora, according to their particular focus areas. Location related features in cellular networks are standardized mainly in 3GPP and 3GPP2, whereas OMA concentrates on

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standardizing solutions independently of underlying network technologies and network specific communication protocols. While the cellular standards have concentrated mainly on standardizing the positioning technologies supported by mobile networks, OMA has concentrated on providing architecture and protocols, enabling location information to be made available through a variety of applications and application services. OMA can therefore be seen as a channel to feed market requirements for the features to be provided by a location enabler, which may provide requirements to cellular standards, if applicable.

The main aim of Nokia in OMA location standardization is to provide a standard access to location features for application development. This is to ensure a variety of business models and a global market place for innovative application business, as well as to ensure interoperability between different equipment. In order to achieve these aims, Nokia sees open standards as a preferred tool for a variety of business opportunities.

Summary

'Life goes mobile' – bringing a society where business and personal lifestyles are changing and evolving ever faster. This calls for flexible products and services that facilitate and support our new routines, and provide pleasant experiences. Mobility and communication are at the heart of people's lives – and as a result, the mobile phone is infused with a rich new meaning.

Currently, the mobile location aware services market is about to take off as the first location aware client server applications hit the market. Today, over 70 operators have launched location aware services.

Nokia is committed to providing an open location aware software platform with Symbian and Java developer APIs and to penetrating a number of positioning systems. In this way, operators and developers are given more room to concentrate on providing the actual applications and services – Nokia, with its proven track record, can assist operators and developers in the realization of all these benefits.

To enable the market, Nokia is currently bringing a whole range of location aware products to the market: location aware consumer applications, platform software as well as the cell ID and GPS technology. Nokia continues to develop the network positioning solution mPosition, focusing on CI and A-GPS technologies.

Nokia supports business models with a full end-to-end architecture. It is up to developers to choose the most lucrative technologies and business models.

Currently the location field as such is very well standardized and Nokia is actively participating in the OMA to define, develop and promote interoperable, common and ubiquitous location services solutions.

Nokia is using developer innovations to ensure that location aware applications take off, but to ensure the mass adoption of these applications and services, all developers and operators in the field need to act now.

Glossary

3GPP	Third Generation Partnership Project for standards organisations and other related bodies to co-operate for the production of globally applicable technical specifications	LMU	Location Measurement Unit
3GPP2	Third Generation Partnership Project 2 for standards organisations and other related bodies to co-operate for the production of globally applicable technical specifications	MMC	MultiMedia Card
A-GPS	Assisted GPS	MLP	Mobile Location Protocol, application-level protocol for getting the position of mobile stations independent of the underlying network technology
API	Application Programming Interface	MLS	Mobile Location Services
CI	Cell ID	MO-LR	Mobile Originated Location Request
E911	Enhanced Emergency Call (US)	MS	Mobile Station
E-OTD	Enhanced Observed Time Difference	OMA	Open Mobile Alliance
FCC	Federal Communications Commission, an independent US government agency directly responsible to Congress	SAI	Service Area Identity
GMLC	Gateway Mobile Location Center	SMLC	Serving Mobile Location Center
GPS	Global Positioning System	SMS	Short Message Service
GPRS	General Packet Radio Service	SUPL	Secure User Plane Location; Enables positioning by employing user plane signaling between the terminal and network server, making the positioning to be independent from the underlying mobile network by using ubiquitous data bearers such as TCP/IP, HTTP and SMS
HTTP	Hypertext Transfer Protocol	TA	Timing Advance
JCP	Java Community Process	TO-LQ	Terminal Originated Location Query
JSR-179	Java Specification Request 179, Location API for J2ME	XSP	External Service Provider
J2ME	Java 2 Micro Edition		

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NOKIA CORPORATION

Nokia Mobile Phones

P.O. Box 100

FIN-00045 NOKIA GROUP, Finland

Phone: +358 (0) 7180 08000

www.nokia.com

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