



**Java™ technology enables exciting
downloading services for mobile users**

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Executive summary

Java technology has established itself as the leading 3rd party application development platform for downloadable mass market applications for mobile devices.

According to analyst estimates* approximately 80-100 million Java handsets have been shipped to the market by the beginning of 2003 and the installed base is growing rapidly as over 20 mobile device manufacturers supports the Java platform. For example Nokia has already shipped tens of millions of J2ME™ (Java 2 Micro Edition) enabled Java handsets to the market by the end of 2002 and in 2003 most of of the new handsets models announced will support Java.

Furthermore the Java language has been one of the fastest growing programming language ever among software developers. Currently it is estimated that there are 3 millions Java developers and many of these developers have started to develop wireless Java applications.

By the beginning of 2003 tens of operators all around the world have deployed or trialed Java services. The early results from many of these Java service launches have been encouraging. Many operators have reported positive user adoption and increased traffic from Java services. Mobile users have warmly welcomed graphical and easy to use Java services such as downloadable games, screen savers and infotainment applications.

Going forward, the strong industry support for the next generation Java platform based on the open MIDP 2.0 specification from the Java Community Process (JCP) will further accelerate Java service take-off due to new richer service capabilities. In addition widespread industry commitment to the Java Technology for Wireless Industry (JTWI, JSR-185), expert group will further increase the consistency of Java handset implementations between different vendors and therefore improve the scale economies in Java application development.

The massive adoption of Java technology has created mass market business opportunies for operators, application developers, content owners, applications service providers and aggregators. So now it's a good time to capture new profits by launching wireless Java services.

* e.g. Gartner, Nov 2002 or ARC Group Feb 2003

Java™ technology enables exciting downloading services for mobile users

Almost everyone has downloaded ring tones and screen icons to their mobile phone. Now, with Java applications, personalization is no longer limited to the outside of the phone. Thanks to Java technology, users can enhance and personalize their phones with graphical, interactive programs, downloaded over the air and stored in their handsets for use when and wherever they want them.

Examples of highly popular downloadable Java applications existing in the market today include fun content such as graphical games and animated screen savers as well as information applications such as weather, news and stock broking applications.

The possibilities of Java technology are virtually limitless. Millions of developers around the globe are gearing up to unleash their creative potential in the wireless world with it.



Figure 1. It is easy for users to go to a portal and download Java game with a few clicks.



Figure 2. Examples of Java services available today.

Java technology: Leading open application development platform for the wireless industry

The Java application development platform consists of both a programming language and an execution environment for downloadable mass market applications designed by 3rd party developers.

One of the key benefits of the Java platform is that it can run on top of several different operating systems. The proven scalability and portability of the Java technology enables it to be implemented across all kinds of mobile devices ranging from basic mass market to high end devices. In addition, the Java platform also has a robust security model that protects the device from harmful applications.

Open global specifications for Java technology have been developed in wide industry cooperation in the Java Community Process (JCP).

The version for smaller devices, such as mobile phones, communicators and PDAs, is known as Java 2 Micro Edition, J2ME™.

Mobile device manufacturers representing over 80 % marketshare support J2ME, so it's clearly the leading global platform for 3rd party application development.

The J2ME platform is not a single specification for a piece of software. Instead it is a collection of technologies and specifications designed for different parts of the small device market.

The core part of the J2ME platform is formed by two different configurations, Connected Device Configuration (CDC) and Connected Limited Device Configuration (CLDC). A configuration defines central Java technology libraries and virtual machine capabilities. CLDC is targeted at the low-cost portable devices like mainstream mobile phones, whereas CDC is targeted at more advanced mobile devices.

On top of the configurations are the profiles that define the key functionality and application programming interfaces (APIs) in a specific device category. There are two key profiles for wireless Java, the

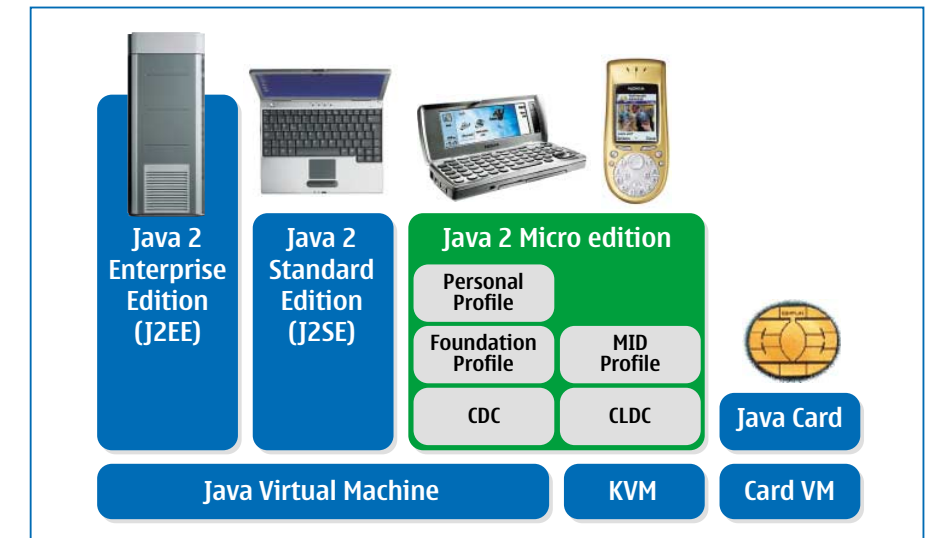


Figure 3. Different Java Editions optimize the Java platform for different uses and devices. The J2ME platform is the edition optimized for mobile devices. J2ME platform includes the Mobile Information Device Profile (MIDP) and the Personal Profile.

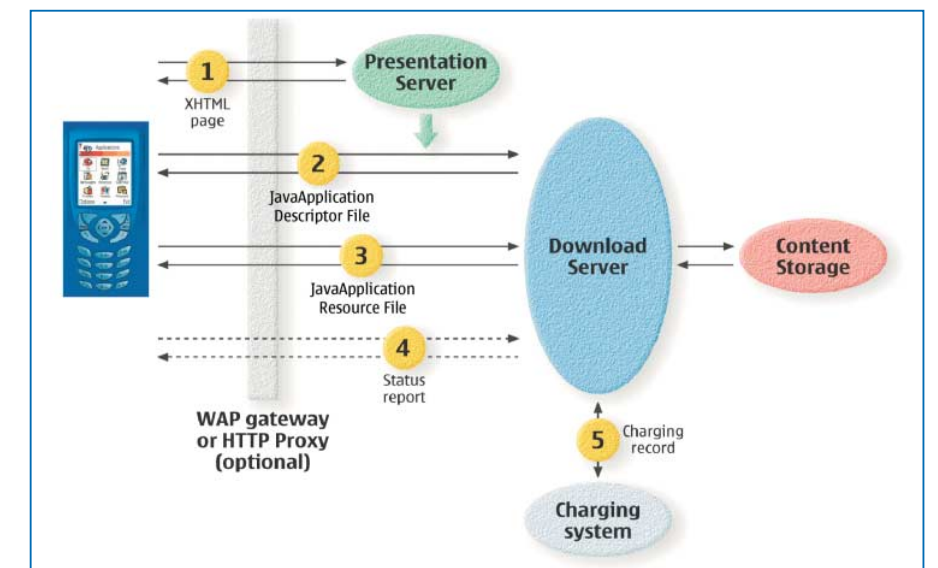


Figure 4. A simple download transaction and required building blocks.

Mobile Information Device Profile (MIDP) and Personal Java. MIDP is a profile for CLDC based portable devices with communications capability, such as mobile phones. It defines functionality such as usage of the user interface, persistence storage, networking, and application model. The Personal Profile using CDC is intended for high-end portable devices like the Nokia 9210i Communicators, for example.

How to download a Java application over the air (OTA) and what it requires from the operator platform

Figure 4 describes the network elements and process involved in a browsing initiated Java application over the air download transaction.

In this case, the mobile user browses color XHTML (WAP2.0) pages and discovers an

exciting Java game. He decides to download the game and clicks the download link, which points to a download server. Now the MIDP over the air (OTA) provisioning process as specified in the Java Community Process (JCP) is initiated and the download server first fetches the Java Application Descriptor file and delivers it the phone. This enables a terminal capability check prior to the delivery of the Java Application Resource file. A status report is sent from the phone to the download server after content installation, which allows reliable charging after a successful download transaction.

The building blocks for downloading Java applications over the air are a WAP gateway or a HTTP proxy. The HTTP protocol or the corresponding WSP protocol in the WAP stack allow any content to be downloaded from a server to a client. The presentation server runs the service portal, which acts as one content discovery and promotion channel. The download server manages content throughout its lifecycle, fetches the right content variant from storage, delivers it reliably to the phone and creates charging information after confirmed successful downloads. In other words, the download server is the element that executes the MIDP OTA provisioning specification, enabling reliable downloading with confirmation to provide the basis for charging. The content storage is a web server that stores the downloadable content. The charging system is used for content and traffic charging based on the reported confirmed successful downloads from the download server.

Wireless Java services enable new business opportunities

Java has become the most widespread 3rd party application development platform in the wireless industry and the installed base of the platform is growing rapidly. This means that there are mass market business opportunities for mobile operators, application developers, content owners and applications service providers/aggregators in launching wireless Java services.

Java offers new business opportunities to mobile operators

With tens of millions of Java handsets on the markets and more on the way, plus a well-established developers community, Java technology offers operators new ways to boost their revenues and differentiate themselves.

A mobile operator is in a privileged situation to build up a successful business of distributing mobile Java applications. Operators can build on existing technical assets to develop the needed over-the-air distribution and charging capabilities, as well as utilize its customer knowledge, channels and brand to market the Java services in the best possible way to its subscriber base.

By launching Java service business in win-win cooperation with content aggregators, service providers, application developers and content owners, operators can get attractive revenues from increased traffic as well as also capture a share of the related content revenues. Furthermore, business models based on new network supported Java services offer plenty of new business opportunities for mobile operators to differentiate themselves from their competitors and hence increase customer loyalty as well as capture new recurring traffic and subscription revenues. Recurring visits and frequent information deliveries take place by offering to customers compelling, continuously refreshing Java content. This may vary from serious content such as news and entertainment through to news to well segmented communities such as fan clubs of a popular hiphop music group etc.

Java services offers new business opportunities for application developers

Today the mobile content business mainly consists of simple ringtones and logos. The rapidly growing installed base of Java terminals opens up a new mass market for application developers designing more advanced and higher value downloadable Java applications. For skilled Java developers the mobile industry offers a market with huge business potential.

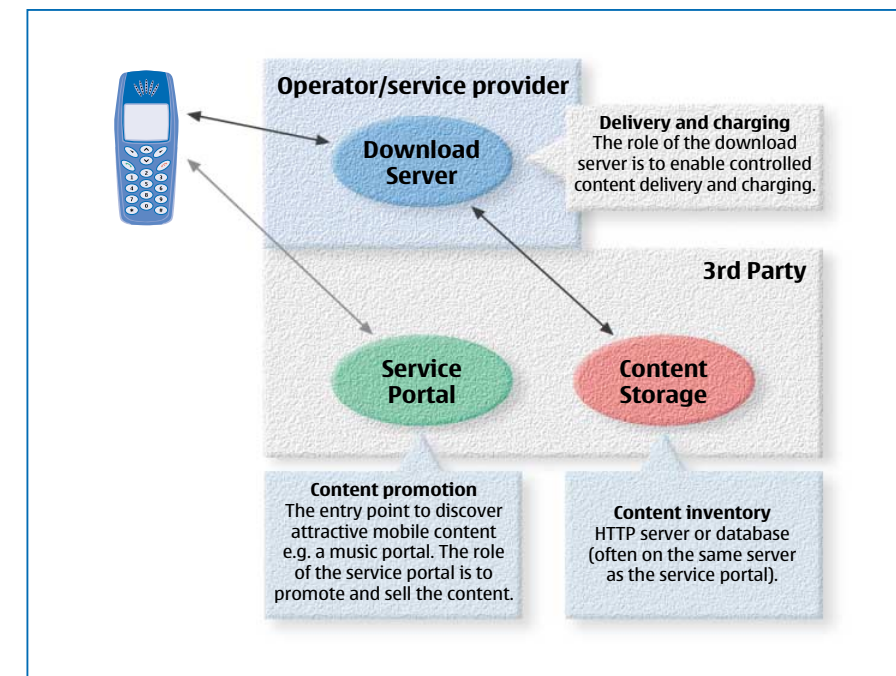
The success factors in the content development are technical superiority combined with artistic competence. Understanding the current and future development of the technological capabilities in the mobile devices and networks is crucial for a sound business and product planning.

Java services offers new business opportunities to wireless application service providers and aggregators

In many countries, wireless application providers and aggregators have successfully partnered with operators and introduced services for downloadable digital content such as premium SMS. Downloadable Java applications such as mobile games fit well with current product offerings. As the targeted customer segment is primarily the same, Java services provide a natural revenue growth path for application service providers/aggregators.

Java services offers new business opportunities to media content companies, trade and financial services

Media companies can provide news Java applications which let their customers view and track news or weather updates in selected areas of interest etc. The possibilities are virtually endless. Financial services can provide stock tracking and trading Java applications to their customers. A supermarket chain can distribute OTA free-of-charge client software that automatically downloads



A wide variety of Java service categories are possible

There are several service categories from which the operator, application developer or service provider can choose when deploying Java to generate new business or to bring additional revenues to existing services. The following main Java service categories can be identified:

- Downloadable Java applications
- Connected Java applications
- Boosting existing services with a Java based user interface

The downloadable Java applications business

The downloadable Java application business has been the most widespread Java business model so far. The first wave of wireless Java business has been based mainly on the sales of downloadable applications like games, animated screen savers etc. Currently the development of Java applications is expanding in scope to to cover more utility and business oriented applications.

In most service offerings today, the revenue model is based on the pay-per-download. By introducing more variety to the pricing schemes (eg different

subscription based model), the Java service provider can generate more recurring revenue streams and build up a longer customer relationship.

Connected Java applications

Some leading service providers have started to develop more advanced Java service offerings that generate recurring revenue streams from the service and usage of the application. In this business model, the revenue stream is more versatile as it is divided between the fee of the application itself and the revenue stream generated while the application is used over the network. Examples of connected applications are:

• Network assisted games

The only limit is the imagination when it comes to advanced features that can be added on top of mobile Java game. The networked element of the application creates end-user loyalty to the service and can leverage the community factor among the users. A high-score service is one example of such a service. Other community elements can be created on the network service. New revenue streams can be created by offering

additional products to be downloaded from the server -game levels, comic strips, animations or any other downloadable content.

• Infotainment services

Interactive information and entertainment services have been launched using SMS or WAP -news, weather, sports, stock quotas etc. A Java client application can provide an alternative or supplementary delivery mechanism. As demonstrated by existing service introduction, successful services will create a substantial user loyalty and consequently decrease the churn.

Boosting existing services with the Java based user interface

The Java application provides an attractive graphical user interface to enhance existing text or WAP based applications. As an example, SMS or WAP based mobile game services are widely used in many countries and generate substantial revenue. End user experience can be clearly improved with the introduction of a Java user interface. Incremental revenues are generated, thanks to a more positive user experience.

Key learnings from successful wireless Java service launches

By the beginning of 2003, tens of operators and a high number of service providers/aggregators all over the world have successfully trialed or launched wireless Java services. The early results from many of these wireless Java service launches have been very encouraging. Many operators in Asia, Europe and US have reported rapid user adoption and significant traffic increases from Java services (table 1).

<p>“25 carriers in 34 markets have deployed or trialed wireless Java services and the number is growing rapidly” (Source: Sun Microsystems, February 2003)</p>
<p>“US operator Nextel reported 660.000 Java downloads in 2002” (Source: Mobile Media Analysts, February 2003)</p>
<p>“German Wireless Application Service provider Jamba reports 140.000 Java downloads/month in November 2002” (Source: Jamba February 2003)</p>
<p>“In December UK operator MM02 reported 100.000 Java downloads after the launch in September” (MM02, December 2002)</p>
<p>“Data traffic of Java handset owners is twice as big than the data traffic of non Java handset owners” (Source: NTT DoCoMo in Japa, November 2002)</p>

Table 1. Facts about early Java launches.

An analysis of several Java service launches identifies the following learnings for creating commercial success when launching Java services:

1. Match the services with selected market segments and terminals
2. Work together with 3rd party partners to get compelling content
3. Invest in educational marketing and ease of use
4. Make service discovery easy, especially with mobile browsing
5. Put charging systems in place

1. Match the services with selected market segments and terminals

Successful Java service players have segmented their user base and then carefully matched their total offering, including content, terminals and marketing messages to target the selected user segments in the best possible way.

By up front designing Java services for clearly defined terminals, Java application developers can both optimize their applications to best fit the specific device capabilities and APIs (Application Programming Interface) as well reach the selected customer segments in an efficient way. For example, Nokia's terminals have been clearly designed, positioned and priced to selected customer segments.

Needless to say, it's also very important that applications are carefully tested on real devices so that they work flawlessly before launch.

2. Work together with 3rd party partners to get compelling content

Successful Java launch cases all over the world stress the basic fact that content is king for service uptake. It is important not only to have a critical mass of Java content portfolio ready for launch but also to update the portfolio frequently as consumers bring valuable data traffic revenues every time they browse and download new applications. Operators should therefore ensure that there is a good reason for consumers to get back to their portal – over and over again.

Services offering richness and freshness call for long term partnerships between operators and content providers. One of

the key attractions of Java is the fact that there is already today a very high number of 3rd party Java developers, service providers and aggregators with whom mobile operators can form win-win partnerships to get access to high quality content and ensure rapid innovation.

Cooperation between operators, application developers, content owners and service providers/aggregators in terms of mutually rewarding business models where both parties have strong financial incentives to invest in developing attractive Java services have reaped dividends. Moreover, clear and fast 3rd party cooperation processes, including quality assurance practices with fast turnaround times, developer tool support and co-marketing have been the ingredients of success for Java service operators.

The importance of Digital Rights Management (DRM) grows as the Java application business expands. The Open Mobile Alliance (OMA) DRM standards released in 2002 provide open standard solutions with strong industry support. These standards include solutions ranging from securing basic copyrights to enabling super distribution, where friends can forward Java content to one another in a way that respects content copyrights and enables business for content owners.

3. Invest in educational marketing and ease of use

As with all radically new services or products, market awareness is low at the beginning. The key barrier to overcome is to get the users to do the 1st critical download. Operators that have achieved rapid uptake of Java services have invested significantly in easy to understand marketing, educating the mobile users on what benefits Java services can offer and how they can discover and download Java applications.

When doing this, it is beneficial to use different media and channels carefully to reach the targeted segments with the Java messages.

Point of sale marketing plays a crucial role in this process. When buying a new terminal, the consumer should be shown demos how to use the attractive Java features in the phone by sales personnel in the store and also get a device that

already has all the necessary settings to begin service usage.

Promotional campaigns at point of sale should be planned and all in store personnel trained thoroughly so that they are able to instruct users on how to use Java services. It is also beneficial to have easy to understand leaflets describing what Java services are, how to use them and how they are priced in the store or in sales packages.

To make it easier still for users to start using Java services, the need for users to do any complex settings must be minimized. Settings can be pre-installed or delivered over-the-air (OTA). The Open Mobile Alliance (OMA) bootstrapping and device management standards provide open standard solutions with wide industry support for OTA provisioning.

In addition to settings, a pre-charged battery adds value to many consumers as they can experience “out of box readiness” and start using their new mobile terminals and their Java services directly after walking out of the store after purchase.

Push campaigns have also produced good results in targeting existing users with Java handsets who haven't done the critical first Java download. It requires basic CRM (Customer Relationship Management) systems where users, their interest areas and approval for notifications are stored. Push campaigns can be done using SMS, MMS and WAP push. Each of them has their own characteristics but the general concept has proven to be effective. When consumers get notification of a personal interest area on their devices at which, the result is invariably very positive. Statistics from several launches show positive consumption trends after push campaigns. This trend also seems to increase usage in the long term.

4. Make service discovery easy especially with mobile browsing portals

Experiences from several Java launches have shown that easy service discovery with tempting promotion are crucial for Java service usage uptake.

Attractive mobile browsing portals, with easy navigation, tempting descriptions and color pictures of the available Java content have been successful in increasing

usage. The importance of making the user experience of mobile portals as compelling as possible gives an indication of the opportunity for the attractive colour user experience, enabled by combining highly graphical XHTML (WAP2.0) browsing and Java download portals.

In addition to browsing, it makes sense to maximize the ways users can discover and access Java services by also enable ordering of Java applications by SMS short codes promoted in printed media, fixed Internet web portals, WAP and SMS push campaigns and even "physical kiosks"/ vending machine points in stores.

There are many terminals with different capabilities (displays types and sizes, Java APIs etc). To ensure the best possible user experience, the network should recognize the terminals and deliver right application variants to consumers. Today, the most efficient way to do this is to identify user agent data, using the Open Mobile Alliance (OMA) device profile UAProf standards. The

UAProf user agent points a link to a repository where the terminal specific capabilities are described. This data allows operators to dynamically filter their portal to display only the content that is supported by requesting terminal type. Another way to utilize terminal type data is to confirm content support after download request, before delivery and charging in the OTA download process specified by JCP.

5. Put charging in place

A crucial part of readiness involves, of course, charging capability – both for applications and data traffic.

Delivery mechanisms as such are easy to implement, but experience shows that having reliable, flexible and manageable charging capabilities requires careful consideration and planning and should be started early on when planning Java service. Today, both SMS and CDR based mechanisms are good options for event

based charging. The integration requirement and network configuration sets the criteria for the charging method selection. To maximize the market potential, it can be important to create pre paid billing capabilities.

Clear and simple pricing models are essential to achieve user acceptance. Pay per download and bill to phone is maybe the easiest for the user to grasp. Also simple monthly subscription based charging models have been used successfully and in innovative way.

Pricing is always an area that requires careful consideration and where there are no easy rules of thumb. Too high prices will kill market growth whereas too low prices mean leaving value on the table. Several of the successful Java launches by operators so far have applied low pricing to stimulate service mass market uptake (for example, 2-5 EUR/USD per download or double this for a monthly subscription).

device by a message (SMS or UDP) entering a pre-defined network address. This can be used for numerous applications and business models. Customers may subscribe to a service that alerts them every time the service is updated or messages get pushed to Java messaging clients (such as e-mail or Instant messaging clients etc) in a convenient way for them. UDP datagrams on the other hand will help in the creation of a new type of near-real time applications like multiplayer games.

The introduction of end-to-end TCP/IP (WAP 2.0) networking will take place in the industry during the second half of 2003. TCP sockets will be useful for various kinds of bi-directional Java services. Development of e-mail and messaging applications will be possible using TCP/IP protocols such as SMTP and IMAP. The TCP/IP introduction will also improve the download speed of large Java files. Furthermore, secure applications like those for banking and financial sector known today in the fixed Internet will be possible using https (based on SSL/TSL) protocol supported by MIDP2.0.

Significant improvements are introduced in the application management area as well. Applications residing in the mobile device can share data among themselves. Using this feature, applications can exchange data instead of the manual data transfer by the user.

The current Java OTA (over-the-air) provisioning mechanism and business models are fully compatible with the MIDP2.0 applications. The OTA definition is now an integral, mandatory part of the MIDP2.0 specification.

More advanced security functions with MIDP2.0

A security mechanism has been introduced in MIDP2.0 that makes it possible for the user to recognize the trust level of an application. One originating from a trusted source may have access to wider resources on the device without prompting the user. Another originating from a source that is not certified either by the device manufacturer or the operator would ask the end-user permission when attempting to access the network, for example.

Other important upcoming Java API specifications for richer services

In addition to MIDP 2.0, there are several other key upcoming Java APIs in 2003 and 2004:

- Wireless messaging API (JSR 120) will enable MIDP Java applications to take advantage of the hugely successful SMS technology. It enables, for example, turn based multiplayer gaming over SMS such as a chess game where the opponent can be invited to the game or chat.

- Mobile Media API (JSR 135) will provide applications access to rich media capabilities. Support for interactive MIDI means that applications can flexibly control MIDI events to create, for example, sound effects in games or to build a MIDI composer application. JSR 135 also supports playback and recording of audio. For example, audio stream can be recorded from the microphone of the device and can be used in a MIDlet. There is also support for camera access. Images and video can thus be used by applications. However, it is important to note that not all the devices that support

JSR 135 will support the whole set of functionality it defines.

- CLDC 1.1 (JSR 139) will be the next version of the core layer of J2ME platform implementation. It will bring several enhancements to the J2ME platform, most importantly support for floating point calculations. CLDC 1.1 will be a key stepping stone to support the further evolution of the J2ME platform. It is needed for applications that require 3D graphics support (JSR 184) or location support (JSR 179).

- A Java application using Bluetooth connectivity will be possible with the introduction of JSR-82. New opportunities are open for proximity applications (content download and access to Bluetooth accessories) and short range community applications such as head-to-head gaming.

- 3D graphics in Java applications will be possible using JSR-184 capability. This is valuable for applications such as games, screensavers or product visualization.

- Using location information offered by JSR-179 extends the spectrum of Java applications radically. They range from information applications such as automatically localized weather forecasts to entertainment applications like location aware gaming or friend finders.

- The personal information management and file connection features of JSR-75 will open new possibilities for productivity applications. A Java application can access the address book or calendar application of the mobile device or it can retrieve and store an image file to the folder directory of the device, for example.

Improved consistency of implementations with Java Technology for Wireless Industry (JTWI, JSR 185)

The leading players in the J2ME space are working within the Java Technology for Wireless Industry expert group (JTWI, JSR 185) to improve the consistency of Java implementation from different players.

The objective of JTWI is to provide visibility to the industry when the key J2ME APIs will be deployed and to

ensure the interoperability of those implementations. The introduction of a commonly agreed set of minimum functionalities provides application developers and service providers with predictability about the consistency between implementations in the market place.

According to the first release of JTWI, the core functionality is as follows:

- MIDP2.0 (mandatory item)
- CLDC 1.0 (mandatory item)
- Wireless messaging API (mandatory item)
- Mobile Media API (recommended item)

The core API set of JTWI will pre-empt the need for proprietary extensions, as was the case in the first round of the Java terminal J market launch. In short, JTWI will strike a blow against fragmentation and thus improve the Java application deployment economies of scale for developers and operators.

Web Services – future opportunities to stimulate innovation in mobile content

Web services technologies such as XML, WSDL, SOAP, HTTP are emerging technologies that will enable more efficient enterprise-to-enterprise integration. In the short term, the key opportunity of Web services in the mobile context lies in open standard server-to-server interfaces enabling more faster and lower costs in service and content deployment partnerships between operators and 3rd party service providers. For example, Web services will enable operator network servers to be connected to 3rd party service provider J2EE™ (Java 2 Enterprise Edition) web / application servers in a standardized way. In the longer term, client side Web services may also open up new opportunities. Currently key standardization work on how to utilize Web services in the mobile industry is taking place in the Open Mobile Alliance (OMA) and the Java Community Process (JCP), for example.

Towards the next generation Java MIDP2.0 platform

The MIDP2.0 or JSR 118 (Java Specification Request) is the core part of the next generation of the J2ME Java specification for mobile mass market devices from the Java Community Process (JCP). The introduction of MIDP2.0 will offer a wide variety of new opportunities for richer and more versatile Java services:

- Radically improved graphics and media features
- Versatile networking features
- More advanced security features
- Thanks to the backward compatibility, MIDP2.0 devices run applications based on MIDP1.0 specifications
- MIDP 2.0 will be an important convergence point for the industry and will act as the bridge bringing together the fragmented Java implementations in a way that improves scale economies in Java application deployment across different devices.

Radically improved graphics and media features with MIDP2.0

Significantly enhanced audio-visual functionality is offered by MIDP 2.0 to

developers who work on graphical applications using multimedia features.

MIDP2.0 introduces several enhancements that make it possible to access to phone functionalities like back light, vibrations, keyboard and sound functions in a standard way. Furthermore, visual enhancements related to rendering, tiling and sprite support and management of graphical layers simplify development and take the graphical user experience to a new level. Audio generation and playback as well as support for vibration are also included. Inclusion of these features replaces the current provider specific extensions that were introduced to complement the MIDP1.0 capabilities.

In short, with MIDP2.0 users will get applications which provide a richer multimedia user experience.

Versatile networking features with MIDP2.0

The push feature (also known as remote service invocation) of MIDP2.0 can be used to activate an application in the mobile

Nokia sees Java technology as a key enabler for new compelling mobile services

Nokia sees Java technology as a key enabler for new exciting services and applications for the mobile handset users and attractive new business opportunities for mobile operators, application developers, content providers and application service providers/aggregators.

Due to the exciting business prospects of wireless Java services, Nokia is strongly committed to deploy Java technology supporting the specifications from the Java Community Process (JCP) in products covering the end to end chain needed for successful Java service launches - terminals, developer community support and servers.

By the end of 2002 Nokia had shipped more than 20 J2ME Java terminal models, resulting in an installed base tens of millions of Java handsets only from Nokia.



Figure 8. Examples of Nokia Java terminals.

The year 2003 is an important milestone year for Nokia in Java technology since most of Nokia terminals models announced will be Java enabled. In addition, Nokia will roll out the MIDP 2.0 platform launch in handsets during 2H/2003.

In brief, Nokia is investing heavily in developing solutions end-to-end to support its customers when launching profitable Java services both now and in the future.

Nokia is committed to J2ME

Nokia's Java implementations supports open global J2ME industry specifications from the Java Community Process (JCP).

Adherence to open standards is in the interest of the whole wireless Java industry as it improves economies of scale for all players in the value chain.

Nokia's current J2ME devices are based on Mobile Information Device Profile 1.0 (MIDP 1.0) and Connected Limited Device Configuration 1.0 (CLDC 1.0). In addition, these handsets support the Nokia User Interface API which provides certain simple graphics enhancements and access to sound, vibration and device lights control. The Nokia UI API was a way to provide the important functionality for entertainment applications that was missing in the MIDP 1.0 standard.

The next big step in Nokia Java platform development will be the introduction of MIDP 2.0 as it provides several important additions to the J2ME platform, enabling richer Java services for users.

Furthermore, Nokia sees that MIDP 2.0 will be an important convergence point for the industry and will act as the bridge bringing together the fragmented MIDP 1.0 based J2ME implementations. For example, MIDP 2.0 standardizes the entertainment functionality provided in the Nokia UI API. Nokia is an active member of JTWI (JSR 185) and will bring JTWI compliant MIDP 2.0 devices to the market.

Coupled with the transition from MIDP 1.0 to MIDP 2.0 there is also an important transition in the network protocol stacks in the Nokia devices. Nokia will move from using WAP stack to TCP/IP (WAP 2.0) stack in the devices. Nokia MIDP 2.0 devices will be based on TCP/IP (WAP 2.0) stack and will not support WAP stack. If operators wish to take advantage of the new capabilities of Nokia's Java MIDP 2.0 devices they need to upgrade their networks to support TCP/IP (WAP2.0) protocol stack.

Nokia will furthermore support OMA DRM and UAProf standards in terminals.

Figure 9 summarises how Nokia lead implementations are planned to support various new J2ME APIs that enable richer Java services for mobile users.

Nokia is working to create economies of scale for Java developers

To improve the economies of scale for Java developers, Nokia has adopted standardized user interface styles. These enable Java application developers to optimize their applications for a limited number of display sizes and input mechanisms, despite the fact Nokia launches a high number of individual handsets.

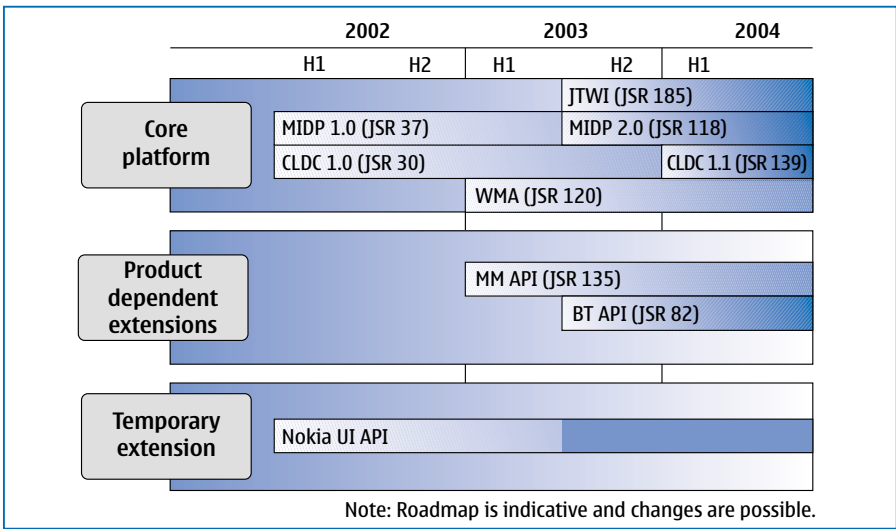


Figure 9. Nokia lead handset implementations are planned to support various new J2ME APIs that enable richer Java services. (Wider deployment in the product portfolio comes after the launch of the lead product).

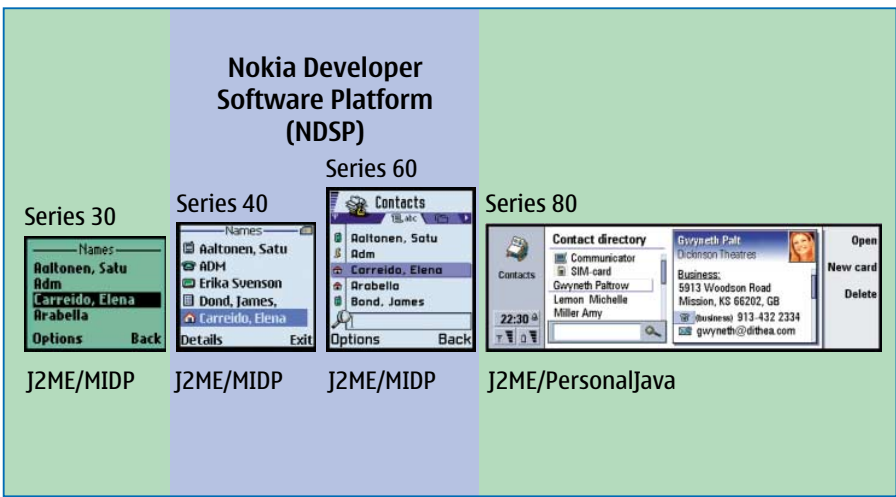


Figure 10. Nokia UI categories and Nokia Developer Software Platform – creating scale economies for Java developers.

Nokia is also implementing a cross device software platform, the Nokia Developer Software Platform (NDSP), that offers the same set of core software facilities and APIs to developers across Nokia's Series 40 and Series 60 UI category terminals.

The first release (1.0) of the Nokia Developer Software platform contains MIDP 1.0, CLDC 1.0, Nokia UI API and Wireless Messaging API (JSR-120). The second release (2.0) of Nokia Developer Software Platform will be based upon MIDP 2.0 as the major upgrade and will be aligned with the Java Technology for Wireless Industry (JTWI, JSR-185) roadmap.

Symbian and Java are emerging as the two leading open application platforms in the wireless industry.

Symbian and Java are rapidly becoming the two leading open application platforms in the wireless industry in terms of installed base. Nokia is strongly committed to both of these two highly complementary platforms.

Nokia sees the Java platform as the preferred execution environment for downloadable mass market applications across Nokia's device range from the basic categories to high end devices. Nokia's Symbian devices are also Java enabled, whereas native Symbian application development in C++ is optimal for state of the art applications fully utilizing the rich device capabilities of Symbian terminals.

Forum Nokia is actively supporting Java application development and sourcing

Forum Nokia, Nokia's global developer community, is the largest of its kind in the mobile arena with the number of registered developers approaching 1 million developers at the beginning of 2003.

Forum Nokia provides the development tools and technical support and services for Java application development on top of the Nokia Developer Software Platform to support the full build-test-sell cycle. A bundle of new development tools and services to support development will be launched during the first half of 2003. With Nokia Developer Software Platform, Forum Nokia provides a ubiquitous platform, tools and an attractive business opportunity for developers globally.

For operators and service providers Forum Nokia offers the services for efficient Java application sourcing. Nokia Tradepoint is the world's leading mobile application and content B2B marketplace, with over 1,500 applications available. The application sourcing possibilities offered by Nokia Tradepoint encompass matchmaking, events and a B2B e-marketplace covering a rich variety of applications up to the most recent Java implementations from leading developers around the world. Nokia Tradepoint offers various alternatives for accessing the marketplace. Operators can select the alternative best suited to them on a case by case basis.

Nokia supplies a carrier grade Java downloading platform

Nokia offers comprehensive Java downloading solution with the Nokia Delivery Server as its key component. The platform enables operators to deploy Java services smoothly.

The Nokia download platform supports open standards from the Java Community Process (JCP) as well as the Open Mobile Alliance (OMA) to enable interoperability with all handset vendors that support these open standards.

The Nokia download platform enables over the air downloading of multiple content types and sizes, such as Java applications as well as polyphonic MIDI ringing tones, Symbian applications and screensavers. For Java content download, the supported standard is MIDP OTA, which is also a mandatory delivery mechanism in MIDP 2.0, while the download of other content is based on the OMA Download OTA mechanism.

To maximize the way users can find and access the services the Nokia downloading platform supports different service discovery methods such as mobile WAP browsing, SMS and Web.

The Nokia download platform enables the operators to cooperate with 3rd parties by offering easy-to-use content management, OMA Digital Rights Management (DRM) and revenue sharing capabilities, manage business rules for content download, fetch content from storage, deliver content reliably to devices and create data for charging of the delivered content. The Nokia platform also supports both pre-paid and post-paid customers.

The Nokia solution has a modular architecture - the integration of the content download platform with the operator's existing infrastructure is easy, saving time and resources.

The solution can be extended with Nokia WAP Gateway that provides access to the download services, Nokia Charging Center that takes care of the charging and Nokia Terminal Management System that allows efficient delivery of the OTA-settings. The solution can be complemented with integration and consultancy.

Conclusions and recommendations

With tens of millions of Java handsets on the markets and more on the way, the Java platform provides mass market business opportunities for mobile operators, application developers, content owners, applications service providers and aggregators.

In the beginning of 2003 tens of mobile operators have succesfully deployed or trialed Java services all around the world. The early results from many of these Java

service launches have been encouraging. So now is a good time to capture new profits by launching wireless Java services.

Looking forward, strong industry support for the next generation J2ME MIDP2.0 Java platform and the Java Technology for Wireless Industry (JSR-185) effort will enable new, even richer Java services and further improve economies of scale in Java application development.

References and links to more information

Java specifications from JCP:
<http://www.jcp.org>
<http://Java.sun.com/products/jtwi/>

Important complementary mobile specifications from the Open Mobile Alliance:
<http://www.oma.org/>

Nokia offering in Java:
<http://www.nokia.com/>
<http://www.forum.nokia.com/>

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