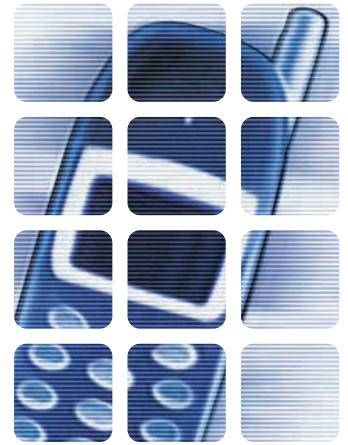


Mobile Commerce Report



[RESEARCHING THE FUTURE // INVESTING TODAY]

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Durlacher Research Ltd

Mobile Commerce Report

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INVESTMENT HYPOTHESIS

The mobile communications market is currently in a state of horizontal consolidation. The era of partnering, which has been one of the telecommunication sector's defining characteristics over recent years, is now being supplanted by more aggressive acquisition-based strategies from major telecoms operators. Global One, Unisource and Concert are examples of some of the less successful transactions from the partnership era. The move to acquisitions is reflected by the recent take-overs of Airtouch by Vodafone, One-to-One by Deutsche Telekom, E-Plus by France Telecom and the current bid for Orange by Mannesmann. Today, mobile operators are increasingly becoming part of the consolidation picture. The mobile operators' current acquisition activities are targeted primarily at optimising the core processes for delivering mobile voice, creating synergy effects in terms of economies of scale and scope and generally reducing the large fixed costs of being mobile operator.

The emergence of mobile commerce provides a significant boost to valuations in the telecommunications sector, a point reflected in the latest valuations per subscriber for wireless operators. Mannesmann has offered Euro 9452 for each Orange subscriber and France Telecom paid Euro 4994 per E-Plus customer. This compares to Mannesmann (Omnitel), Deutsche Telekom (One-to-One) and Vodafone (Airtouch) all paying below Euro 4600 per subscriber in earlier take-overs during 1999. In comparing the 1999 revenue multiples of European (mobile) telecommunications operators (market capitalisation/1999 revenues), one finds that they generally lie in the range of 3 to 5. Similar multiples for traditional content companies vary widely between about 2 (e.g. Dow Jones, Disney) and 20 (e.g. Reuters)

Until now mobile operators have simply not experienced an internet type valuation, but with the arrival of mobile internet and mobile commerce, this might well change rapidly. Mobile operators will play a more active role providing portal services and content to their users. Multiples for major portals range from 60 (AOL) to 245 (Yahoo!). Mobile operators are likely to move in the same kind of direction. Large mobile operators do have the advantage that they already have a large number of users and an established billing relationship with those customers. Our investment hypothesis is that mobile operators will shift away from offering mostly voice services to become a true portal for the mobile terminal and beyond.

We believe that Europe is about to experience an explosion in the uptake of WAP (Wireless Application Protocol) technology which will lead quickly to interim capacity constraints requiring investments in more bandwidth capacity. GPRS (General Packet Radio Services) will be the first mainstream technology to bring the real advantage of mobile internet to the user, through its provision of "always on" connections. While GPRS/EDGE (Enhanced Data for GSM Evolution) technology will enhance theoretical bandwidths to match those of UMTS (Universal Mobile Telecommunications System), this technology will not provide any large scale capacity relief, rather it is expected to fill up available capacity even further. For this reason, we believe that the market will require significant investment in third generation UMTS technology, which will substantively solve capacity problems. From an investment perspective, we believe that Bluetooth technology will also emerge as a key enabler for a very wide spectrum of applications.

Increasingly, mobile operators will derive revenues from content and services, and will compete to develop a value-added user experience. In so doing they will become content aggregators and portal players allowing mobile to take its (very valuable) place in the internet jigsaw.

HIGHLIGHTS

The European m-commerce market is expected to grow from Euro 323 million last year to Euro 23 billion by 2003 and is currently about two years ahead of the US in development terms. Currently equipment vendors are creating over-hyped expectations on the development of the mobile commerce market. Mobile web browsing will not become a reality before 2002.

Broad market uptake of mobile commerce will be delayed until the main obstacles for early market success are addressed. These obstacles include that little content and few applications are likely to be available initially, call set-up time is too long and few WAP (Wireless Application Protocol) devices are in stores. At the beginning of 2002, mobile commerce in Europe will start to take off on a bigger scale, as GPRS (General Packet Radio Service) starts to become more widespread.

Mobile advertising will be the number one mobile commerce application (23%) by 2003. The mobile device provides unrivalled one-to-one marketing capabilities, which the direct marketing industry will exploit moving forward. Mobile financial services, e.g. stockbroking, banking and payment (21%) as well as personalised, often location-based mobile shopping services (15%) will also contribute significantly to market development. Mobile entertainment will become a major driver for mobile commerce only after 2003 using EDGE and UMTS.

The initial killer application for mobile internet services will be e-mail based on the current success of SMS (Short Message Service), which is necessary to pave the way for more transactional m-commerce services. Instant messaging from the mobile phone will start to substitute e-mail as GPRS arrives. Unified messaging will become mainstream technology by 2001. Mobile video telephony will not be an important application for mobile devices within the next 4 years.

Smartphones will become the standard mobile device from 2002 onwards. These devices will include a WAP microbrowser, which enables wireless internet access. The other main category of device will be so-called communicators (where Nokia has led the way), which have been derived from PDAs (Personal Digital Assistant) and which are equipped with or linked to a mobile phone. The borders between mobile phones, PDAs and consumer electronic devices will begin to blur after 2001. Phones with an integrated MP-3 player or a video player will appear in the market around this point.

Mobile operators are ideally positioned to lead the mobile commerce market as they possess comprehensive customer data, such as demographics, calling patterns and a detailed profile, as well as an existing billing relationship. Moreover, the operator owns information about the subscriber's geographic position, which facilitates the offering of location-based services, such as advertising, shopping, reservations and information provisioning.

In the near future, mobile operators will have to undergo a major change in order to position themselves as mobile portal providers, content aggregators or WASPs (Wireless Application Service Provider). Considering the different business models for serving the increasing mass market demand for mobile phones and for building a mobile portal, a split-up of network operator organisations into mobile voice and mobile portal is likely.

We expect that, based on their unique customer relationship, the first mobile operators will move upwards in the value chain into the banking sector by acquiring a bank or a banking license in 2001. The mobile phone incorporates ideal characteristics for ensuring secure electronic payment and we believe that it will become the de facto electronic wallet in Europe.



METHODOLOGY

Research for this report commenced in May 1999, and in the interceding months much has happened in the communications market. Indeed, there are few areas where the words written on one day have not been superseded within days by further market developments. As will become evident through the report, there are numerous additional notes that illustrate these market changes, and explain how they affect its future.

Notwithstanding this volatility, we have published this report with the intention of providing operators, investors, mobile commerce service and equipment vendors, banks and others, with a pragmatic view and analysis of the m-commerce market in Western Europe today. We have also made our best efforts to forecast how and when this market will grow, and outline the applications that will drive adoption.

The report does not aim to provide an exhaustive overview of the m-commerce market place or the enabling technologies. In particular it should be noted that we explicitly exclude in-depth analysis of any of the equipment vendors or operators. Other market reports and technical documents are available that fulfil this role. In this report, we attempt to discuss important technological trends and mobile commerce applications that will be enabled through this environment, and evaluate them according to their ability to deliver business benefit in relation to other communications and commerce solutions.

Many of these observations are not unique to Western Europe and we believe that these regional trends provide some indication of the wider global market.

PRIMARY RESEARCH

Over the past seven months, we have conducted original research and interviews across Europe, and have exchanged ideas with many operators, banks, equipment vendors, service platform developers, application vendors, content providers and portal companies.

We have built a view on the market that cuts through the hype that has been created in the last few months around mobile internet and m-commerce in particular. Our understanding of the relevant developments in this particular segment has been shaped through discussions with industry leaders.

However, the market is just being created, growing out of the earlier "mobile data" classification into what is being regarded as m-commerce today. In such a new marketplace, it is almost impossible to extrapolate long term trends from an early, developmental snapshot.

SCOPE

The report is divided into nine main sections, Today's Market, M-Commerce Market Drivers, M-Commerce Enabling Technologies, M-Commerce Enabling Applications, Consumer M-Commerce Applications, Business M-Commerce Applications, Market Sizing and Forecasts, Industry Outlook and Investment Opportunities. These sections are further complemented by our views on how these technologies and markets will evolve to provide growing momentum to the m-commerce applications market, how these applications will shape over time and how the various players will react to such developments.

INTRODUCTION

DEFINITION OF MOBILE COMMERCE

The working definition of Mobile Commerce for the purposes of this report is any transaction with a monetary value that is conducted via a mobile telecommunications network. In this report, we refer to Mobile Commerce as M-Commerce, Mobile Electronic Commerce or Wireless Electronic Commerce, using these terms interchangeably.

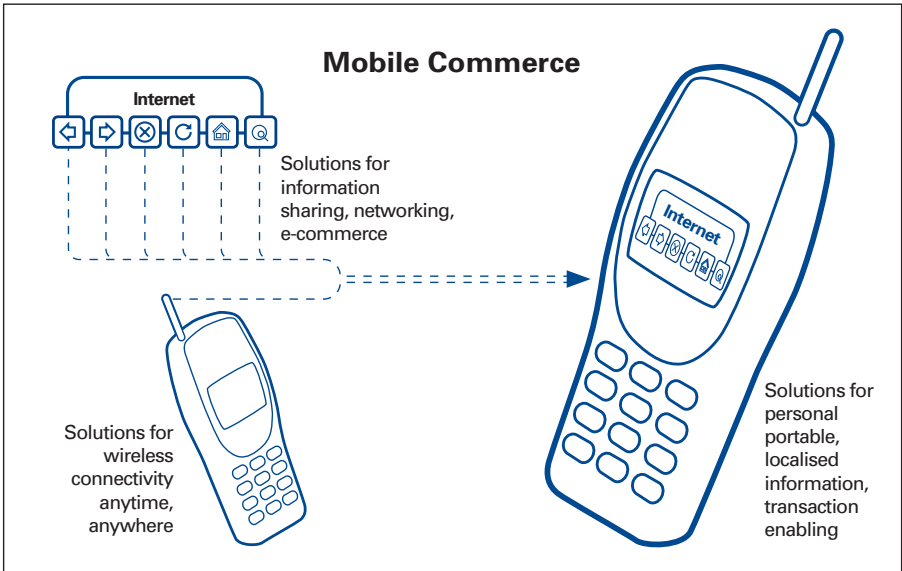


Figure 1 Source: Durlacher

According to this definition, m-commerce represents a subset of all e-commerce transactions, both in the business-to-consumer and the business-to-business area (m-commerce will not only expand its share of this market, but will expand the market overall, through the rapid uptake of m-commerce services).

Therefore, regular SMS messages from one person to another are not included in the definition of mobile commerce, while SMS messages from an information service provider, that are charged at a premium rate, do represent mobile commerce according to our definition.

Until now, the term "mobile data" has always been used for everything which is non-mobile voice. We believe that this terminology is slightly outdated, today's m-commerce is all about applications and services on the mobile phone. It is not about capacity, it is about content.

Europe (specifically, Western Europe) has been the primary focus of this report despite the fact that key e-commerce trends and business models usually derive from the United States. This is because, in the specific area of mobile communications, Europe has adopted a clear lead in terms of usage and application development. Europe has a high penetration of mobile phones and has successfully adopted a single standard, GSM (Global System for Mobile Communications) which dominates the wireless world throughout the continent. The US has not been able to reach this single standard nor has it managed to settle on a generic type of terminal, thereby retarding the arrival of a critical mass of handsets in the open market for the introduction of new services. Instead, a wide selection of both analogue and digital devices as well as all types of pagers can be found in the US.



TODAY'S MARKET

BACKGROUND

Mobile commerce applications that combine the advantages of mobile communications with existing e-commerce services will be very successful, but we will also see entirely new services built around the mobile. Some of the key drivers for the increasing sophistication of the mobile market are:

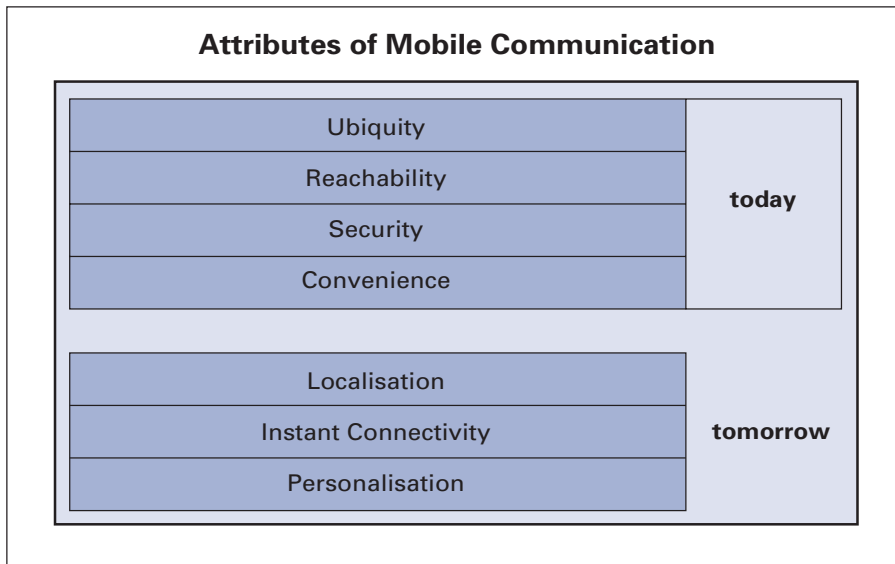


Figure 2 Source: Durlacher

Taking these drivers in turn:

Ubiquity

Ubiquity is the most obvious advantage of a wireless terminal. A mobile terminal in the form of a smart phone or a communicator can fulfil the need both for real-time information and for communication anywhere, independent of the user's location.

Reachability

Reachability is important for many people who want to be in touch and be available for other people. With a mobile terminal a user can be contacted anywhere anytime. The wireless device also provides users with the choice to limit their reachability to particular persons or times.

Security

Mobile security technology is already emerging in the form of SSL (Secure Socket Layer) technology within a closed end-to-end system. The smartcard within the terminal, the SIM (Subscriber Identification Module) card, provides authentication of the owner and enables a higher level security than currently is typically achieved in the fixed internet environment.

Convenience

Convenience is an attribute that characterises a mobile terminal. Devices store data, are always at hand and are increasingly easy to use.

Enhanced functionality that will become available, based on technological advances, on tomorrow's devices will include the following:

Localisation

Localisation of services and applications will add significant value to mobile devices. Knowing where the user is physically located at any particular moment will be key to offering relevant services that will drive users towards transacting on the network. The mobile operator will soon know where the user is physically located, so for instance a

businessperson arriving on a plane into Helsinki can expect to receive a message asking whether she needs a hotel for the night.

Instant Connectivity

Instant connectivity to the internet from a mobile phone is becoming a reality already and will fast-forward with the introduction of GPRS services. With WAP or any other microbrowser over GSM, a call to the internet has to be made before applications can be used. Using GPRS it will be easier and faster to access information on the web without booting a PC or connecting a call. Thus, new wireless devices will become the preferred way to access information.

Personalisation

Personalisation is, to a very limited extent, already available today. However, the emerging need for payment mechanisms, combined with availability of personalised information and transaction feeds via mobile portals, will move customisation to new levels, leading ultimately to the mobile device becoming a real life-tool. So, returning to the businessperson landing in Helsinki, if she responds ‘Yes’ to the question regarding the hotel room then the network will advise her what is available in her price range (and will match any other variables she may have input through her personalisation tool).

We believe that we will see the following path for m-commerce service deployment in Europe. Although mobile e-mail is not considered to be a commerce application (rather a communications application), it is featured in the chart in order to reflect the key role it has in developing the market.

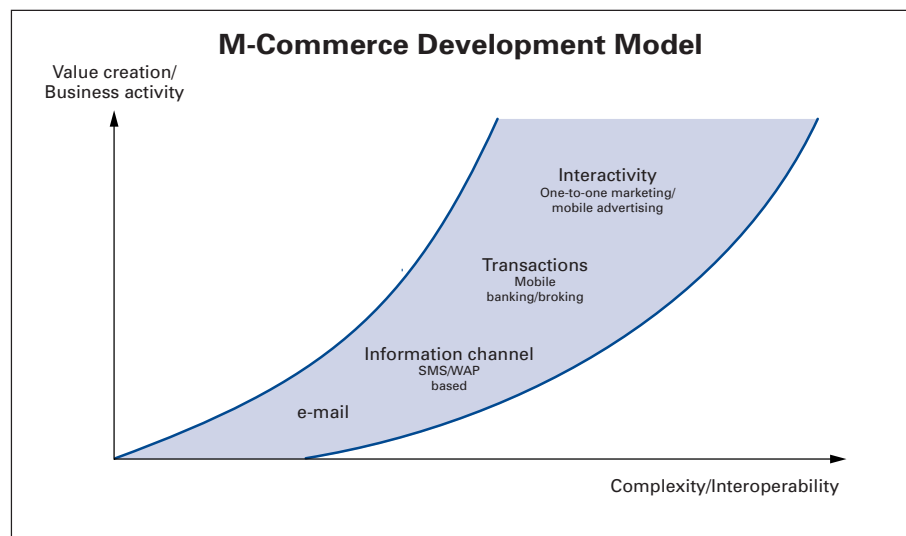


Figure 3 Source: Durlacher

MOBILE COMMERCE MARKET DRIVERS

The following principal drivers are responsible for the growth expectations of the mobile commerce market.

Mass Market Mobile

With mobile communications reaching the mass market, network operators are facing decreasing ARPU (Average Revenue Per User). Price erosion for mobile voice service is faster with 3rd, 4th and sometimes 5th mobile operators having entered the market in many European countries. There is a common understanding throughout the industry, that within a 2 to 3 year period mobile tariffs will come down to the same level as fixed tariffs. The network operators must continuously implement new services on their networks if they want to slow or turn around the trend of decreasing ARPU.

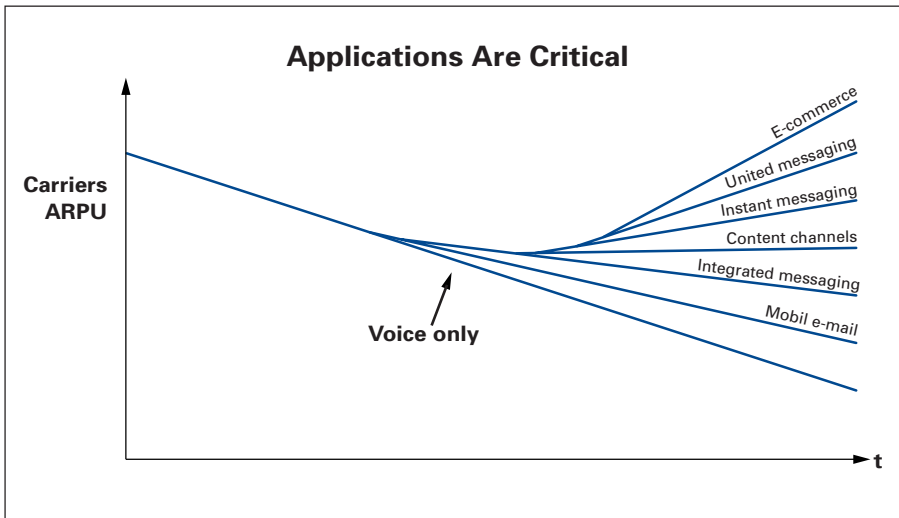


Figure 4 Source: Microsoft

Mobile data and SMS services have not been very successful in the past, generating usually no more than 2-3% of an operator's turnover, although in Finland a 7% revenue share has been reached. Since SMS is mainly used for communication between people in the 15-25 year old age group, they have earned themselves the title "Generation Text". The power of SMS can be seen in countries such as the Philippines where it is a national phenomenon amongst the youth market.

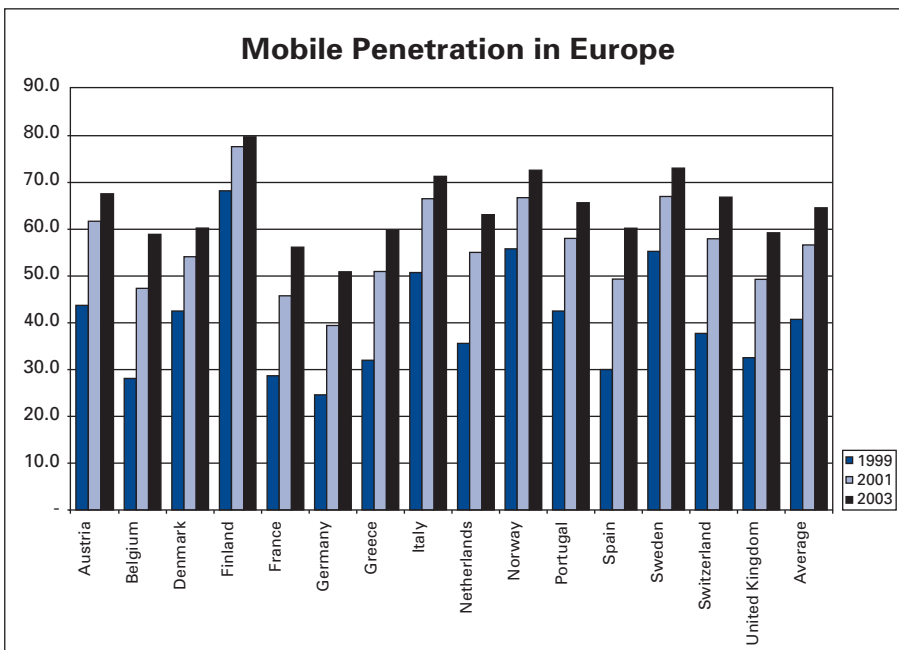


Figure 5 Source: Dataquest, Mobile Communications International

The number of mobile phone subscribers is going to outnumber the number of fixed line telephone lines. The point of mobile dominance has been reached already in some countries in Europe, such as Finland, which reached a mobile penetration of over 65% during summer 1999. It is important to point out that although mobility of people is increasing, the need for content remains location-dependent according to the "business is local" principle. Thus, we believe that content offerings will change with the location of the user.

Mobile commerce is the strongest future potential source of revenues for operators once wireless bandwidth becomes more or less a commodity. The purchase of goods and services or the trading of stocks via a mobile device is no longer considered to be simply a wireless data or mobile value-added service. They are key commercial transactions, which happen to be conducted in a mobile environment.

Booming Wireline Internet

The current number of internet users is indicated below in comparison to the number of mobile phone owners. The gap between those numbers is particularly large in Southern European countries, such as Italy, Greece and Portugal.

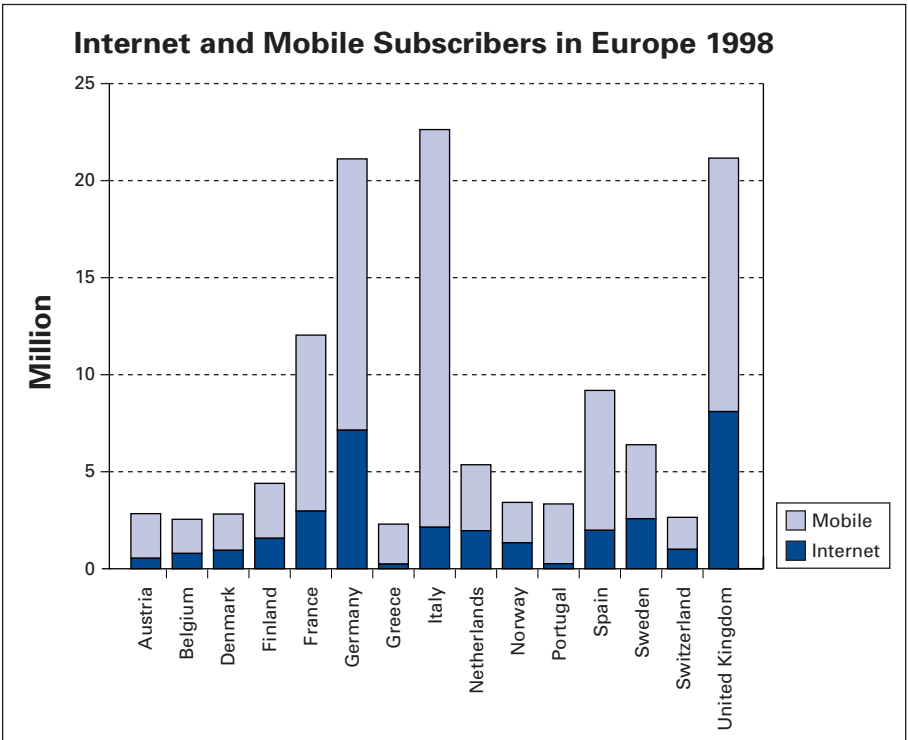


Figure 6 Source: Dataquest, Mobile Communications International, Computer Industry Almanac

E-commerce is growing rapidly throughout the world as more and more people are getting online. In 1999 European E-commerce has reached a volume of about Euro 8 billion according to Forrester Research. A larger part of the population is undergoing its first online shopping experience.

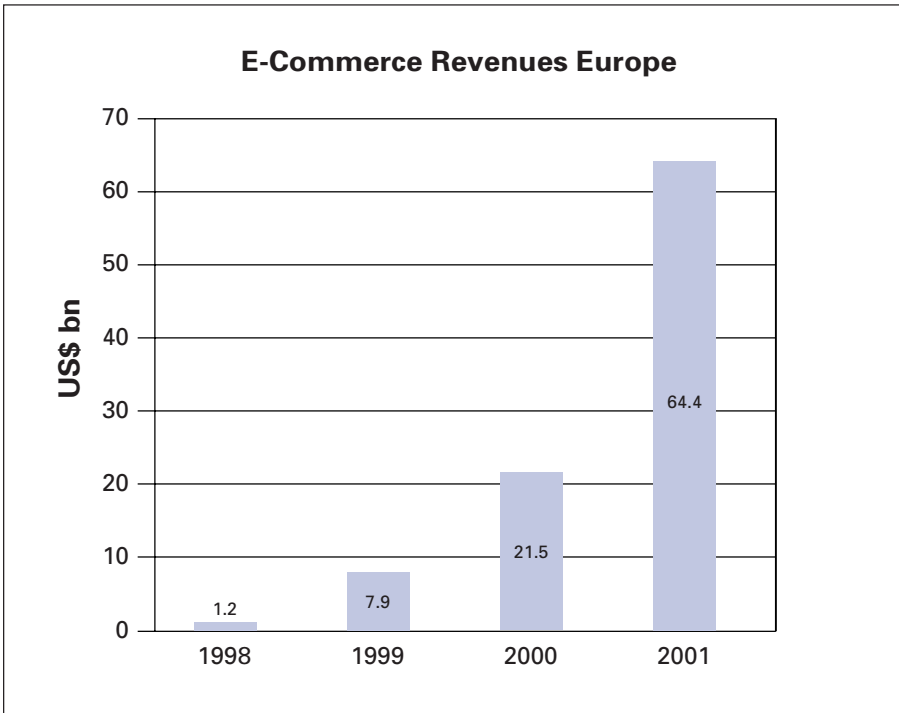


Figure 7 Source: Forrester

Most forecast numbers are based on the on-line population on PCs with internet capability, but this model does not withstand the arrival of new tools for integrating internet functionality: WebTV, smartphones and communicators. Mobile commerce is *per se* not included in the traditional e-commerce market models. M-commerce will be able to increase the overall market for e-commerce, because of its unique value proposition of providing easily personalised, local goods and services anytime and anywhere. We believe that m-commerce will be adopted rapidly in Europe because of the high usage of mobile data services and because of increasing exposure to fixed line e-commerce.

The increased competition in regional markets (with up to 5 cellular players/market offering virtually identical services at often identical tariffs) puts a further pressure on service differentiation as each player tries to distinguish their position in the competitive landscape. Mobile commerce in all its shades will provide a key differentiator for a network operator, who must be forward thinking and innovative to move successfully from being a pipe (infrastructure provider) to become a content aggregator (mobile portal) and customer solution provider (systems integrator).

Supplier Push

The push from equipment vendors for WAP gateways and microbrowser-enabled smartphones is helping to drive the market for mobile commerce. Telecom99 has been the climax of the market hype so far, with mobile internet generating cover stories in all major economics publications.

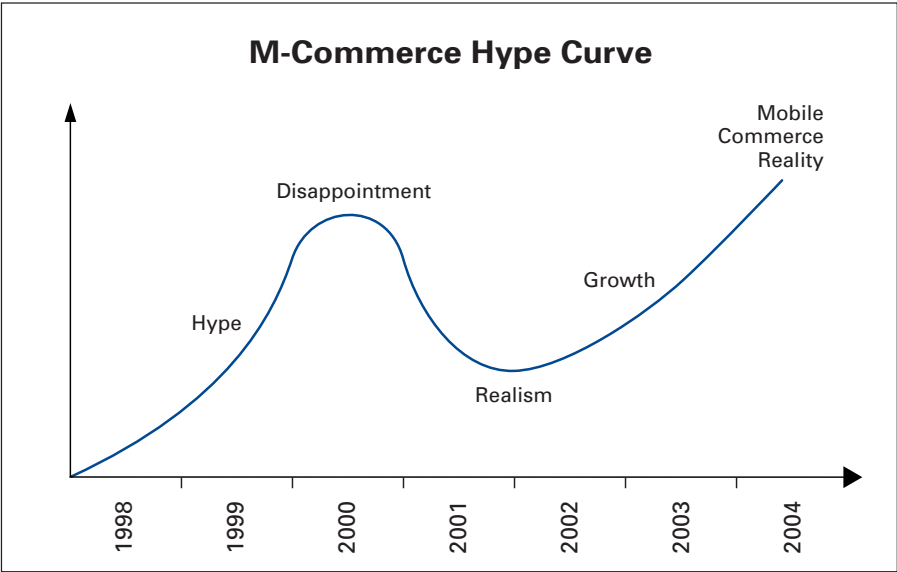


Figure 8 Source: Durlacher

We believe that the hype will eventually cool down, before the true uptake of m-commerce becomes a reality by 2002. Although the rate of innovation is very high within the mobile and internet industries, false expectations in terms of equipment availability and functionality (e.g. realistic network capacity) are created.

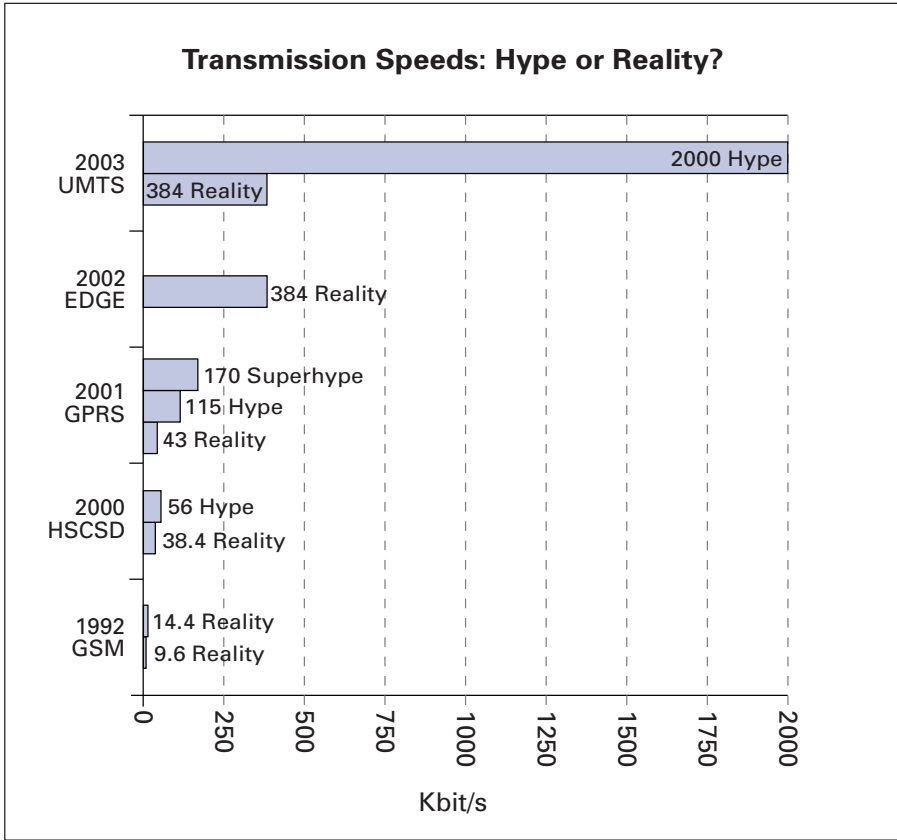


Figure 9 Source: Durlacher



New Billing Principles

With the arrival of GPRS, per minute pricing of mobile services, as we know it today, will not be relevant any longer. Instant access to the internet requires an "always on" mode, necessitating some new form of pricing mechanism. This infers a commodisation of bandwidth. However, a shortage of bandwidth until the introduction UMTS in 2003 limits somewhat the extent to which mobility can be viewed as a commodity. In our view this is an issue which sits on the critical path in the adoption of new services.

The new pricing model favoured by the operators will likely be (in the initial instance at least) a series of flat monthly rates for a certain amount of traffic. The operator needs then only to roughly control the traffic volume to ensure that it is not too far over the allotted volume. This approach also takes into account the *bursty* (meaning significant intensive peaks of usage followed by periods of protracted troughs) nature of GPRS traffic. For the customer this would make life easier in one sense as they would have to calculate only one price. But on the other hand, no consumer will know how many packets they really use in a month, and indeed the billing metric itself is a somewhat technical one.

Alternatively, services could be charged based on value-based pricing. This would relate to various price tags for certain services whether they are stock trades, e-mail or maps for example. NTT DoCoMo has been using this model successfully since February 99 for their *i-mode* service, the first operational mobile portal.

We believe that the acceptance of this second model, value based pricing, will ultimately drive the success of mobile commerce, because it is a model that customers can understand. It is likely that many services will be provided for free, such as news services, while transactional services will be paid for, maybe even by the selling partner. The packaging of these services over networks may be brokered by an m-infomediary rather than directly by the operators themselves.

UMTS Licensing

UMTS licenses are being awarded in most European countries during the year 2000. Only Finland has completed the licensing procedure already, by giving the UMTS licenses to holders of the current GSM licenses during March 1999. The award of limited packages of radio spectrum, which will enable IP (Internet Protocol) based services to be accessed using the same handset all over the world, will be mostly used to increase competition and add new market players. Companies from the media industry such as Bertelsmann and strong marketing organisations such as Virgin are planning to compete for UMTS licenses, as are all the existing mobile operators and a few of their foreign counterparts. The licenses are expected to cost some Euro 100 million in each of the countries.

MOBILE COMMERCE VALUE CHAIN

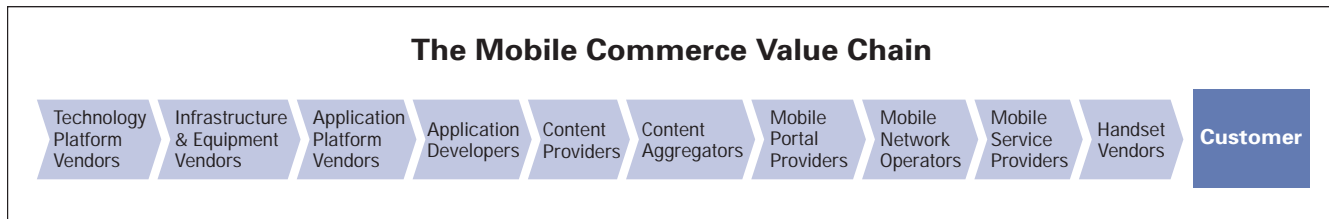


Figure 10 Source: Durlacher

Technology Platform Vendors

The technology platform vendors are delivering the operating systems and microbrowsers for mobile devices such as smartphones and communicators. The battle for the dominating OS (Operating System) has been reduced to two major camps of players, Microsoft and its followers with *Windows CE* on the one hand and *Symbian* with *Palm* on the other hand. *Symbian*, the industry consortium now comprising Psion, Motorola, Ericsson, Nokia and Matsushita began by building upon Psion's *EPOC* operating system, and has now agreed to collaborate with 3Com, owner of the popular *Palm OS*. The challenge will be to combine the *PalmOS* with *EPOC*. Nokia, from its position as the mobile industry's innovation leader, seems to be the most likely party to make this happen.

The microbrowser market is today largely dominated by Phone.com (formerly Unwired Planet), who have gained support from all major mobile phone manufacturers except Nokia and Ericsson, who are marketing their own microbrowser products.

Infrastructure Equipment Vendors

The leading suppliers for mobile network infrastructure equipment: Motorola, Ericsson, Siemens, Nokia and Lucent, have developed solutions for mobile data, mobile internet and thus for mobile commerce. They are creating significant hype around the entire topic and are driving the mobile industry with the speed of innovation and new technology developments such as WAP, HSCSD (High Speed Circuit Switched Data), GPRS, EDGE and UMTS. In this sense the technology is well ahead of the market since to a large extent applications are yet to be developed which utilise these developments.

Application Platform Vendors

A particular key driver for providing wireless internet applications is the availability of middleware infrastructure, i.e. WAP gateways at either the mobile operator's site or at the corporate customer's site. The companies, who have developed their own WAP stack include Phone.com (who also acquired Apion), Nokia, Ericsson and Dr. Materna.

In order to drive the industry and to formulate standards, interest groups have been formed in addition to ITU (International Telecommunications Union), ETSI (European Telecommunications Standards Institute) and the GSM MoU (Global System for Mobile Memorandum of Understanding), such as the WAP Forum, the Mobile Data Initiative, Bluetooth Special Interest Group, GAA (GPRS Applications Alliance) and the UMTS Forum. They are setting de facto standards by assembling the key players and agreeing workable development conditions much faster than the traditional standards bodies.

Application Developers

Applications for the mobile environment are currently being built primarily on *Windows CE*, *Symbian's EPOC32*, or *PalmOS* technology platforms. Currently, most of these applications are used off-line rather than via the mobile network. However, WAP is receiving increasing support from developers, who are going initially after the smartphone market rather than the PDA market. This makes a lot of sense if one compares the number of PDAs sold in Western Europe (1998: 1.4 million) to the number of mobile phones (1998: 90 million).



There is an army of developers working on applications for SIM Toolkit and especially WAP. While there have been a number of applications built based on SMS applications by companies such as WAPIT (Finland) and Dr. Materna (Germany), there is an easy migration from SMS to WAP. This migration is likely to be realised over a period of time, during which time both platforms are likely to be offered. Revenues are generated today with SMS-based information services, while WAP service revenues are likely to come on stream during 2000, dependent on the arrival (in volume) of the long awaited handsets.

As the CEO of a Finnish WAP-start-up puts it: "Everyone who can chew gum walking down the street, is now doing WAP". Although this might be true for Finland and Sweden, where a lot of development activity is taking place, we believe that the number of available applications is still very limited and many more players are going to enter this market.

Content Providers

Technologically advanced content providers are moving into the mobile space to be ready for when mobile commerce will happen. They are using a variety of distribution channels for their products according to the axiom "when content is king, distribution is King Kong". For example, Reuters is delivering its information via partnerships with Ericsson and Nokia as well as via existing portal sites, such as Yahoo! and Excite, who are building mobile portals as well. Additionally, Reuters is building its own mobile portals in a number of markets, having recognised the emerging importance of mobile as a distribution channel. Other early content providers include Consors, the online brokerage, Multichart, the stock exchange information provider and Webraska, the traffic news company.

Charging for content is difficult in a mobile commerce world, even though users are accustomed to paying for value-added mobile services. The easiest way to create revenues for mobile information providers is by taking a share in the call revenues. However this model is classic first generation and it is our view that differential and dynamic charging structures (based on value) will rapidly evolve once the industry takes off. In future, advertising, sponsoring and subscription models will also be realised. In Germany, for example, it is expected that there will be more than 1500 mobile services, many of these subscription based, available on WAP by the end of 1999.

Content Aggregators

A new category of content aggregators is starting to emerge that repackages available data for distribution to wireless devices. The added value is in delivering content in the most appropriate package. One example is Olympic Worldlink, which has developed a solution called *Mobile Futures*, that provides real-time information from the futures and options markets as well as financial market, company, political and general interest news. It also adds trade data from exchanges and clearing houses the world over. Another UK company, Digitallook.com, is providing a service that lets PDA (Personal Digital Assistant) users download share prices and news headlines from the BBC, CNN and AFX. However, it is not yet dynamically updated via the mobile network.

Mobile Portals

Mobile portals are formed by aggregating applications (e-mail, calendar, instant messaging etc.) and content from various providers in order to become the user's prime supplier for web-based information that is delivered to the mobile terminal. Mobile portals are characterised by a greater degree of personalisation and localisation than regular web portals, since the success of m-commerce applications is dependent on ease of use and on delivering the right information at the right moment. This is something which we at Durlacher refer to as the *value-for-time proposition* and, moving forward, will be a key dynamic in determining the success or otherwise of mobile (and indeed other) services. It has been estimated that every additional click-through which a user needs to make in

navigating through a commercial online environment with a mobile phone reduces the possibility of a transaction by 50%. MSN Wireless and Yahoo! Mobile are among the first portals to offer service for the mobile community, but they are still very much focussed on the US. Mobile operators across Europe have put first portals out, e.g. BT Cellnet with its *Genie*, Telia with its *MyDOF* (My Department of the Future), Sonera with its *Zed* or Deutsche Telekom's T-Mobil subsidiary with *T-D1@T-Online*.

Mobile Network Operators

Operators, such as Mannesmann, Orange, Telia or TIM (Telecom Italia Mobiles), are best positioned to benefit from the introduction of new m-commerce services, because they already own a billing relationship with the customer and they control the portal which is pre-set on the SIM card when it is distributed. The operator's intention is to position itself in a key role for mobile commerce by owning the portal and participating in the revenues accrued by services over its network. Those revenues will be significantly higher than the sheer increase in call minutes or volume, particularly as the incremental price per minute falls to zero. The mobile operator has the opportunity to become an ISP (Internet Service Provider) in the sense that the mobile network is going to be built on IP technology with UMTS and that the operator will provide a transport pipeline for content services. Therefore, numerous operators are trying to move up the value chain.

Mobile Service Providers

The phenomenon of mobile service providers as an intermediary for faster marketing and sales of mobile phone contracts and terminals has been seen in many European markets. The service provider has the contract and billing relationship with the customer, but does not own any infrastructure. They are buying the services at a discount of typically 20-25% and can sell them under their own brand. The mobile network operator determines the functionality of services and therefore dominates the information displayed on the screen. However, control over the billing relationship puts the service provider in the position to offer m-commerce applications by charging goods and services directly to the phone bill, if the network operator has provisioned for it.

The influence of service providers is slowly decreasing. While there is currently overall strong subscriber growth, service providers have been growing less than the overall market. Most valuable service providers have by now been acquired by larger telecom operators (Talkline by Tele Denmark, debitel by Swisscom), enabling these operators to gain a customer base without deploying costly infrastructure.

Handset Vendors

Handset vendors are critical in the value chain. Generally, customers do not shop for a particular service provider or network operator, but rather for the handset brand. The emergence of the mobile phone as not only a consumer electronic device, but also as something personal such as a pen or watch, has created lots of value for the handset brands.

In mobile commerce, the handset vendors are a bottleneck in bringing new devices to the market, that support not only SIM (Subscriber Identification Module) Toolkit, but more importantly WAP, GPRS and W-CDMA (Wideband-Code Division Multiple Access). Innovation cycles are becoming continuously shorter, but significant m-commerce will not take place before the right end-user terminals are widely available. The handset vendors have to develop a wider variety of products, as future applications will require different combinations of features. Handsets, optimised for music download and listening, video streaming and watching, computing, game playing or just managing one's life will become possible choices.

At the same time, mobile handset manufacturers are coming closer to the traditional PDA manufacturers, as they are both offering smartphones and communicators with combined



functionality. Production capacity problems with respect to the expected large quantities of phones needed by the market are likely, considering that the total demand for mobile phones is going to almost triple over the next 5 years.

Customer

For consumers, mobile commerce will be a new experience, since thus far most of them have used their mobile phone primarily for voice, and more recently for SMS messages. According to a Nokia study on mobile VAS (Value Added Services), the primary target markets for m-commerce consumer services are:

- Teens (18 years and under)
- Students (19-25 years old)
- Young business-people (25-36 years old)

The business market can be divided into three main categories of organisations that possess distinct m-commerce needs:

- Sales-driven organisations, such as manufacturing companies and banks
- Service-driven organisations, such as consultancies and system houses
- Logistics-driven organisations, such as taxi companies or courier services

Depending on which segment it falls under, a company will become more likely to use a specific mobile commerce application, such as CRM (Customer Relationship Management), fleet management or integration of mobile devices into corporate ERP (Enterprise Resource Planning) systems.

Finally, it should be pointed out that payment agents play an important role as an enabling force in the m-commerce value-chain, although the dominant mode of payment for m-commerce services has yet to be determined. Banks have been traditionally the natural providers of payment agent services. Now they are becoming increasingly concerned about the future role of mobile operators, who allow their subscribers to charge purchased goods and services to their telephone bill (e.g. Sonera). Therefore, the banks themselves are becoming front-runners in mobile commerce in order that they do not become disintermediated.

Merita Nordbanken has for example established its own proprietary *SOLO* payment system for e-commerce and m-commerce payments, while Visa, Cartes Bancaires and Barclays Bank are all experimenting with potential payment solutions for mobile commerce services.

M-COMMERCE ENABLING TECHNOLOGIES

We will not see significant growth in the mobile commerce market until the necessary enabling technologies are developed and deployed. We analyse below the various technology enablers we feel will contribute to the development of the market, and assess their impact on m-commerce in Europe.

NETWORK TECHNOLOGIES

Mobile protocols are all very similar and are ultimately chasing the same applications. All of the protocols are client-server based and involve new functions on the mobile phone and new servers connected to the mobile phone network. Although there are several overlaps, one needs to analyse these protocols to identify the potential winner (the protocol that will gain the strongest support in the market from an application point of view). The protocol that delivers the strongest commercial value at any point in time will be supported by the largest number of attractive applications, and therefore, will jockey into the lead position.

GSM

GSM (Global System for Mobile Communication) operates in the 900 MHz and the 1800 MHz (1900 MHz in the US) frequency band and is the prevailing mobile standard in Europe and most of the Asia-Pacific region. GSM is used by more than 215 million people (October 1999), i.e. representing more than 50% of the world's mobile phone subscribers. North America has only about 5 million GSM users in late 1999, while the majority of subscribers are using a variety of technologies for mobile communications, including pagers and a high percentage of analogue devices. Additionally, the North American mobile market development is handicapped by the "Called Party Pays" principle, which has led to a low usage of mobile phones. In Europe, the common GSM standard provides the critical mass to make it economically feasible to develop a large variety of innovative applications and services. Thus, we believe that Europe and Asia will be at the forefront of the development in m-commerce and about 2 years ahead of the US. However, an increasing number of very innovative solutions is coming out of the US for the m-commerce market, e.g. from Spyglass, W-Trade and Aether.

HSCSD

HSCSD (High Speed Circuit Switched Data) is a circuit switched protocol based on GSM. It is able to transmit data up to 4 times the speed of the typical theoretical wireless transmission rate of 14.4 Kbit/s, i.e. 57.6 Kbit/s, simply by using 4 radio channels simultaneously. HSCSD services are being launched during Autumn 1999 by operators such as E-Plus and Orange. In total there are only 18 GSM operators worldwide who intend to offer HSCSD service, before they introduce GPRS.

The key problem in the emergence of this market is that there is currently only Nokia who can provide PCMCIA modem cards (CardPhone 2.0) for HSCSD clients, which offers a transmission speed of 42.3 Kbit/s downstream and 28.8 Kbit/s upstream. The typical terminal for HSCSD is a mobile PC rather than a smartphone. Call set-up time is still 40 seconds needed for the handshake of the modem. Application usage is more like existing mobile connections to the internet and intranet, which are used especially for accessing e-mail services. The frequent business traveller seems to be the primary target market. Other vendors are expected to hit the market soon with alternative HSCSD terminals.

We believe that HSCSD is an interim technology and that it will mainly be used for speeding up existing mobile data applications. The opportunity window for HSCSD is limited as GPRS services (which offer instant connectivity at higher speeds) will be going into operation by late 2000. The impact of HSCSD on mobile commerce will therefore be very limited.



GPRS

GPRS (General Packet Radio Service) is a packet switched wireless protocol as defined in the GSM standard that offers instant access to data networks. It will permit *burst* transmission speeds of up to 115 Kbit/s (or theoretically even 171 Kbit/s) when it is completely rolled out. The real advantage of GPRS is that it provides an “always on” connection (i.e. instant IP connectivity) between the mobile terminal and the network. Network capacity is only used when data is actually transmitted. It will be available in the second half of 2000 in the first GSM networks in Europe. The actual speed of GPRS will be initially a lot less than the above dream figures: 43.2 Kbit/s downstream and 14.4 Kbit/s upstream up to 56 Kbit/s bi-directional some time thereafter. GPRS will be the first transport mode to allow full instant mobile internet access and will become the enabler for a wide range of applications. In this sense it truly may pave the way for UMTS.

Pilot GPRS networks are already in place today in many European markets. However, GPRS will require new terminals that support the higher data rates, and these seem to be the bottleneck to the early adaptation of the technology. So far no handsets have been released, but they are scheduled for Q3/2000. In order to push the development of applications for GPRS, the GAA (GPRS Applications Alliance) was founded in October 1999 by Ericsson, Palm, IBM, Lotus, Oracle and Symbian.

We believe that the availability of a large number of applications is critical for the take-up of GPRS as a bearer technology for internet access. Implementing innovative billing and pricing systems will be necessary to make the shift away from a per minute charge. According to our evaluation, since both are packet-based technologies, GPRS will be widely installed by operators as a step in the evolution towards the UMTS world.

EDGE

Enhanced Data Rates for Global Evolution (EDGE) is a higher bandwidth version of GPRS permitting transmission speeds of up to 384 Kbit/s. It is also an evolution of the old GSM standard and will be available in the market for deployment by existing GSM operators during 2002. Deploying EDGE will allow mobile network operators to offer high-speed, mobile multimedia applications. It allows a migration path from GPRS to UMTS, because the modulation changes that will be necessary for UMTS at a later stage will already be implemented.

While a number of mobile operators are considering implementing EDGE as an interim data technology between GPRS and UMTS, the success of EDGE depends very much on the timely availability of the products and applications. We believe that the opportunity window for EDGE will be very short, unless major delays occur during UMTS deployment.

3G

3rd generation (3G) is the generic term for the next big step in mobile technology development. The formal standard for 3G is the IMT-2000 (International Mobile Telecommunications 2000). This standard has been pushed by the different developer communities: W-CDMA as backed by Ericsson, Nokia and Japanese handset manufacturers and cdma2000 as backed by the US vendors Qualcomm and Lucent.

After long negotiations the intellectual property rights were cross-licensed between Ericsson and Qualcomm in June 1999, and it looks as though there will be a “peaceful co-existence” of standards. The goal of being able to have one single network standard (CDMA) and use one handset throughout the world seems to be capable of being reached. But within the one standard there will be 3 optional, harmonised modes (W-CDMA for Europe and the Asian GSM countries, Multicarrier CDMA for North America and TDD/CDMA for the Chinese). The first 3G network is expected to be in operation by NTT DoCoMo in Japan by late 2001.

UMTS (Universal Mobile Telephone System) is the third generation mobile phone system that will be commercially available from 2003 in Europe. First licenses have been granted in Finland, but the rest of Europe will award the licenses starting from 2000. Although many people associate UMTS with a speed of 2 Mbit/s, this will be reached only within a networked building and indeed only with some further development to the technology. Realistic expectations suggest a maximum capacity in metropolitan areas of 384 Kbit/s, at least until 2005.

This is in fact the same transmission rate that can be realised much earlier with EDGE. In fact, some mobile operators are currently reconsidering their UMTS roll-out plans due to concerns relating to the capacity differentials and the cost/benefit of migrating from one to the other. Durlacher believes that, considering capacity problems are a major challenge for GSM operators (because of higher penetration rates and the expected boom in mobile data and m-commerce traffic), it makes sense for mobile operators to invest early in UMTS in order to win a share of the available UMTS spectrum.

The business case for operators to provide nationwide UMTS coverage (comparable to that achieved with GSM) is still negative. Therefore, initially only metropolitan areas will be covered by UMTS networks. Forced sharing of infrastructure, as demanded by the UK regulator OFTEL, is likely to be imposed in many markets in order to foster the operator focus on new services rather than solely on building the network.

SERVICE TECHNOLOGIES

SMS

Since 1992 Short Message Service (SMS) has provided the ability to send and receive text messages to and from mobile phones. Each message can contain up to 160 alphanumeric characters. After historically finding it tough going in the GSM markets, during the year 1998 SMS started suddenly to explode. In October 1999, there were about 2 billion SMS messages sent per month within the GSM world, doubling the number six months earlier. The latest figures show that SMS has taken off, with exponential growth experienced in many markets once the 20% penetration threshold was reached.

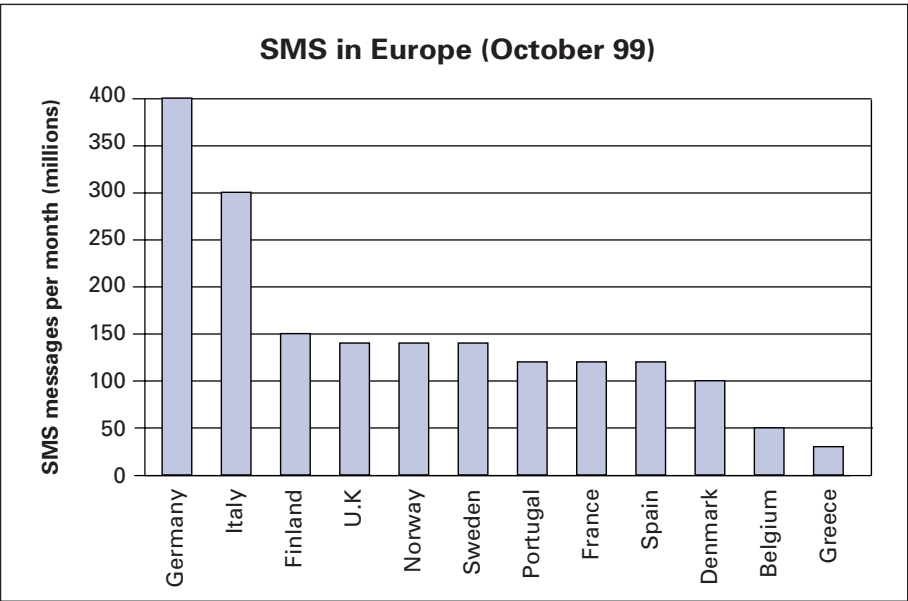


Figure 11
Source: GSM Association, Durlacher



About 90% of SMS messages are voice mail notifications or simple person-to-person messaging. The rest is mobile information services, such as news, stock prices, sport, weather, horoscope, jokes etc. Additionally, SMS e-mail notification, SMS chat and downloading of ringing tones has been offered recently in some markets. SMS services can be customised using SIM toolkit technology. SMS is an ideal technology for pushing information from one-to-one or one-to-few.

We expect that SMS will show rapid further growth, with the number of messages doubling every half a year. SMS will benefit from the hype created with the arrival of WAP. It will continue to be available until at least 2005, but it will lose importance and become part of an advanced messaging solution built around instant messaging via GPRS and e-mail. Many m-commerce applications will be initiated using both SMS and WAP as a platform, until the latter has sufficient support on the handset side.

USSD

Unstructured Supplementary Services Data (USSD) is a means of transmitting information via a GSM network. It is to some extent similar to SMS, but in contrast to SMS, which is basically a store and forward service, USSD offers a real-time connection during a session. The direct radio connection stays open until the user or the application disconnects it. A USSD message can have up to 182 characters. It is relevant for real-time applications, such as mobile stocktrading, where a confirmed information transmission is needed. USSD is a WAP bearer service.

We believe that USSD will grow with the further market penetration of WAP. We see it used mainly for mobile financial services, shopping and payment.

Cell Broadcast

Cell broadcast (CB) is a technology that is designed for simultaneous delivery of short messages to multiple mobile users within a specified region or nation-wide. CB is similar to SMS, but it is a one-to-many service rather than a one-to-one or one-to-few. At the moment, only those users that are within the broadcast area when the message is sent can receive the messages. It is a mass distribution media mainly for news and generic information. The user has to turn on the particular channel in order to receive the news from a selected provider, so that spamming can be avoided.

Usually, cell broadcast services are distributed to the consumer on a no cost basis. The business model works in such a way that the network operator charges the content provider for sending the messages and the content provider will try to make money on follow-up services. For example, a free news service could turn into a paid for service after six months, when the customers grow accustomed to it. Alternatively, follow up revenues could be realised with a premium rate phone service, where additional detail is provided. Platform vendors include Logica Aldiscon, Telecast, CMG and Sema.

We believe that cell broadcast might become a technology to be used in convergent offerings for internet communities or followers of sticky local 'passion centre' content such as football, music, or cars. It could also be used to provide a city information service fed by a local newspaper.

SIM Application Toolkit

SIM Application Toolkit (SAT) technology allows network operators to send applications over the air as SMS or as Cell Broadcast message in order to update SIM cards with changed or new services.

SIM Toolkit applications are built in Java for a client server environment. SAT servers have been built by smartcard specialists, such as Gemplus, Giesecke & Devrient and Orga, as well as independent developers, such as Across Wireless of Sweden. SIM Toolkit

handsets have been developed by all major cell phone manufacturers. But because there are many different classes of the protocol, although all claim to be built on the GSM standard, not all handsets allow all applications. In contrast to SAT, WAP provides a more web-centric/thin client environment, that is easier to manage and to maintain.

SIM Application Toolkit is targeted at phones that do not yet fall into the smartphone category. Small programs can be fairly simply created by the network operator. For example, SAT defines how the mobile phone talks to a bankcard, which is inserted into a dual slot phone. This is also the same technology being used to allow users to download new ringing tones.

Security is a key feature of SIM Toolkit, since data confidentiality and integrity are already included in the standard. Mobile banking has been the trial application with the strongest demand for SAT, but mobile e-mail and mobile information services have been also helping the demand for it.

We are of the opinion that, although SIM Toolkit is being heavily pushed by the smartcard industry, it will be an interim technology and will not be able to survive once GPRS terminals hit the market, since WAP will be the GPRS-supported protocol. WAP 2.0 will include SAT.

However, SAT is available now and it enables numerous trial applications today that can be tested for demand and impact in the market. SIM Toolkit helps to create the market, awareness and business models for mobile commerce, but many operators are directly implementing WAP.

WAP

WAP (Wireless Application Protocol) is an open, global standard for mobile solutions, including connecting mobile terminals to the internet. WAP based technology permits the design of interactive, real-time mobile services for smartphones or communicators. The WAP Version 1.1 specifications were announced by the now over 200 member strong WAP Forum on June 30, 1999. The primary goal of the WAP Forum is to bring together companies from all segments of the wireless industry value chain to ensure product interoperability and ultimately growth of the market. The wireless application protocol with its different protocol stacks compares to the internet protocols as follows:

Wireless Application Protocol (WAP) vs. Internet Protocol	
Internet	Wireless Application Protocol (WAP)
HTML Javascript	Wireless Application Environment (WAE) WML
HTTP	Wireless Session Protocol (WSP)
	Wireless Transaction Protocol (WTP)
TLS - SSL	Wireless Transport Layer Security (WTLS)
TCP/IP UDP/IP	Wireless Datagram Protocol (WDP) WCMP User Datagram Protocol (UDP)
	Bearers SMS USSD GPRS CSD CDPD HSCSD ETC

Table 1
Source: Au-System Radio, Durlacher



There is little doubt about the future success potential of WAP and even companies like 3Com and Microsoft have recently joined the WAP Forum. WAP is compatible with GSM 900, GSM 1800 and GSM 1900, CDMA and TDMA (Time Division Multiple Access) wireless standards as well as the proposed 3G communication systems.

In our view in order for WAP to make an impact on the market, the following three criteria must be met:

1. The penetration of WAP terminals must be sufficiently high
(Status: first WAP phones to hit the shops only by year end 1999)
2. Relevant WAP applications, which really provide added value should be made available
(Status: applications are limited and not location based, personalisation has to improve)
3. WAP gateways must be installed at operators or corporates in such a way that users can access WAP based services
(Status: gateways are only being installed slowly)

The big advantage of WAP is that it makes it easy and user friendly to receive and react to information on the mobile telephone. Therefore, WAP is expected to lift the entire area of mobile information services to a new plane, one, which the SMS world is only a poor approximation of. WAP has been able to gain support from all major players in the market. Therefore, we are convinced that WAP is likely to succeed. WAP based information is also optimised for GPRS, so that the transition will be very smooth to the "always on" mode.

We believe however, that as more advanced services, such as mobile broking and banking, mobile advertising and mobile shopping, are offered, increasing value is added to WAP. After all it is the applications that will make it successful. We believe that after 2001 no mobile phones will be shipped that are not AP enabled.

Web Clipping

In the United States the web clipping service for 3Com's *Palm* handheld device has been very successful. The *Palm* has a 75% market share of PDAs in this market. Web clipping is a *Palm* proprietary format for delivery of web-based information to *Palm* devices via synchronisation or wireless communication to the *Palm VII*. Avant Go is the primary content aggregator of web clipping services. A number of prominent content providers including *AOL Instant Messenger*, Amazon.com, UPS, Fedex, Yahoo! and others have developed real time content for wireless delivery via this service. This service does not have the same recognition in Europe, primarily because of lack of availability of the *Palm VII* device and its wireless network in Europe. 3Com has no plans to launch the *Palm VII* in Europe. Web clipping may co-exist with WAP in the fragmented US market. However, in Europe it is likely to be superseded, even on the Palm platform, by WAP based services.

MExE

The Mobile Station Application Execution Environment (MExE) is, essentially, the incorporation of a Java virtual machine into the mobile phone. The purpose of MExE is to provide a framework on mobile phones for executing operator or service provider specific applications. It allows full application programming. The protocol is integrating location services, sophisticated intelligent customer menus and a variety of interfaces, such as voice recognition. MExE will incorporate WAP, but also provides additional services exceeding the WAP functionality.

We believe that MExE might be built into future UMTS phones, which will have the processing power to run the Java programs. For application developers it will be increasingly important to develop their products for more than one protocol, since many of the above protocols will be in the market at the same time. MExE will be the next logical step after WAP.

MOBILE MIDDLEWARE

A number of middleware platforms are emerging with the arrival of m-commerce:

Mobile Portal Platforms

Oracle is offering a *Portal-To-Go platform*, which was known earlier under the name *Project Panama*. It allows mobile operators to translate web pages into WML (Wireless Mark-up Language) format pages, so that they can be read by AP enabled smartphones. Spyglass' *Prism* is a similar platform.

In contrast, IBM has linked its *MQSeries Everywhere* middleware technology to let mobile workers with smartphones and communicators exchange data with back-office systems. It is a key component of IBM's "pervasive computing" initiative under which the company develops technology, products, and services for portable devices and embedded systems. Thus, the same software is run on mobile devices as on back end systems. Oracle is providing links between company databases and database software embedded in wireless devices as an alternative.

@Motion of the US has also announced the development of a wireless portal for carriers or traditional portal providers that lets them launch an internet voice portal including text to speech and browser entry. The German company Dr. Materna has also developed a packaged portal solution for mobile operators.

Mobile Commerce Platforms

A variety of vendors are currently positioning themselves in the market for middleware solutions for m-commerce. For example, the middleware m-commerce server from Logica provides an interface between a retail bank and the mobile operator, so that bank information, bill payment and electronic value download can be supported from the mobile phone. HP has come up with an integrated m-commerce platform, that is a hardware, software and services bundle based on WAP and which integrates HP technologies like *e-speak* and third party software. Intershop has also developed its a sell-side *m-commerce* platform with Danet from its former e-commerce product, which is used for example by T-Mobil in Germany.

Oracle has developed its Oracle *8i Lite 4.0* database for the use of data and applications by a mobile workforce. They have been first to support smartphones and communicators based on *PalmOS* and *Windows CE*, but IBM and Sybase are already following along the same lines.

Mobile Payment Platforms

Mobile operators are generally deploying proprietary billing solutions from vendors such Kenan (acquired recently by Lucent), Logica or LHS. These platforms have been developed for per minute charging of standard voice, SMS and premium rate calls only and not for charging for particular content. Kingston-SCL is providing its billing solution to France Telecom Mobile and is charging for weather, news and traffic information on WAP.

Payment solutions targeted especially for the mobile market have been developed for example by start-up More Magic Software, which is financed by Siemens' Mustang Ventures. This Finnish company has developed *MBroker*, a micropayment platform that lets mobile operators bill for diverse content and services rather than on a per minute basis using a variety of payment methods. Brokat is offering one of the leading e-payment solutions with its *Twister* platform.



Mobile Banking Platforms

Mobile banking and trading platform or solution providers are evolving very quickly and include the following players:

OVERVIEW OF THE KEY MOBILE BANKING AND BROKING TECHNOLOGY PLAYERS:

Category	Suppliers
Mobile financial service providers	Aether Systems, w-Trade and EmailPager (all US), Multichart, Teledata
Mobile data service providers	GIN (acquired by Saraide.com), Research in Motion, Multichart
Mobile software developers	Brokat, Yellow Computing, Netlife, Aspiro, DataDesign
Mobile system integrators	IBM, HP, Logica
Mobile communications software/gateway companies	Apion (acquired by Phone.com), Phone.com, Nokia, Digital Mobility, 724 Solutions (Citibank with Sonera), Sonera SmartTrust, CMG
Mobile operators	Mannesmann Mobilfunk, T-Mobil with T-Online, Cellnet, Cegetel/SFR, NTT DoCoMo, Swisscom, Telia

Table 2 Source: Durlacher

In the US, Aether Systems are the main suppliers of mobile banking technology. Aether, partly backed by Reuters, IPO-ed in October 1999, with a share price rise of 200% on the first day of trading. They have been tasked to bring Charles Schwab, the world's largest on-line broker, into the mobile world.

MOBILE COMMERCE TERMINALS

Operating Systems

The operating system for mobile terminals is not standardised and currently there is an ongoing battle to become the technology standard of the future. Each of the operating systems is gathering a number of application developers around them, who mostly develop their products for one OS only. There are three major players, who have each developed their own operating system.

Microsoft has developed a lighter version of its *Windows* operating system, called *Windows CE*, that has been created especially for small palm-size, hand-held PCs and other consumer electronics devices. A large number of handheld computer/PDA manufacturers mostly coming from the PC industry, such as HP, Casio, Philips and Compaq, have developed their devices around *CE*. However, *CE* has faced problems surrounding ease of use, robustness, synchronisation and memory requirements. Philips was first to announce the production halt of its *Nino* PDA, weakening further the position of the Microsoft *Windows CE* camp. Instead Philips sees the future in AP enabled phones that will take over some of the palmtop's functionalities.

Symbian is a consortium of leading mobile handset manufacturers Nokia, Motorola, Ericsson, Matsushita and UK PDA manufacturer Psion, and was established in June 1998. Together these handset manufacturers produce more than 58% (Dataquest 1998) of the world's mobile phones. The operating system, which is based on Psion's earlier software, is called *EPOC*. It is especially designed for two types of wireless information devices: smart phones (mobile phones with add-on applications and PC connectivity) and communicators (handheld computers with connectivity to or built-in mobile phones). They have the market power to push through *EPOC* for the smartphone category, which will outnumber the PDA segment by far. Therefore, we believe that Symbian can succeed against Microsoft if it is able to manage its shareholders' (potentially divergent) interests.

1. Symbian's microbrowser supplier is STNC of the UK. STNC was bought by Microsoft in May 1999 and this was viewed as a strategic acquisition striking at the heart of its competition. Similarly, Microsoft acquired Swedish Sendit AB in July 1999, for its *Internet Cellular Smart Access* server and also its mobile communication protocol, which is licensed by Symbian for use in *EPOC*. This two hits are likely to harm Symbian's time to market. Some believe Microsoft have understood internally that Symbian is the top competitor and primary threat to its future extension plans in the mobile market.
2. The *EPOC Release 5* comprises an application suite that includes a wide variety of communication tools (e-mail, fax, SMS, synchronisation), PIM (Personal Information Manager), office functionality and utilities. It is used in the recently released *Psion 5mx*. Nokia is currently still using its self-developed *GEOS* operating system in its *Communicator 9110* product until the end of 2000, but is moving over to *EPOC* for its new developments.
3. 3COM is the smallest player for mobile terminal operating systems, but it is the global market leader in the PDA market (72% according to IDC in 1998) with the *Palm Pilot* product and its proprietary OS. The operating system is regarded to be inferior to its competitors', but the Palm is much simpler to use in both software and hardware terms. 3COM is intending to spin-off its Palm division in 2000 and IPO it. The *PalmOS* has a particular wide acceptance in the US, where the *Palm VII* with its wireless connectivity and web clipping technology has hit the market already. However, in Europe there will be a different type of device based on WAP.

Under increasing pressure from Microsoft, Psion and 3Com as well as Nokia and 3Com have decided to work more closely together in developing a common standard. Psion and 3Com have agreed to make their operating systems compatible. Earlier Qualcomm had lined up with Palm to create the *PdQ* communicator, despite its joint interests with Microsoft in *WirelessKnowledge*.



In addition to its existing product developments, Nokia decided not to await further discussions, to license *PalmOS* and to produce a combined OS of both Symbian's *EPOC* (as a base) and the *PalmOS* (running over it). The goal is to produce a top-of-the-line hybrid communicator consisting of the palm pen-based UI (User Interface) and a wireless earpiece.

This alliance was necessary and makes a lot of sense for all parties creating as it does a win-win situation. Microsoft will be the likely loser to this powerful group, which brings the US and European market leaders in the PDA market together with the three global mobile phone market leaders. A much closer co-operation or a merger between those parties seems necessary in order to create a true combination of their operating systems.

Whoever takes over the Palm division will determine whether the market goes towards *CE* or *EPOC*. Microsoft might be very interested in eliminating another competitor in order to clear the way for *CE*.

Physical Terminals

There is going to be a large variety of mobile devices/interfaces in the market that will provide a fit for the various consumer segments. We distinguish the following categories, but note that the borders between them are blurring:

1. Mobile phone: today's mainly dumb devices with voice only capability (e.g. *Motorola StarTac*)
2. Smartphone: a mobile phone with added applications and PC connectivity (e.g. *Ericsson R380*, *Nokia 7110*, *Alcatel OneTouch*)
3. Communicator: a PDA-type equipment integrated with or attached to a mobile phone for data and voice (e.g. *Ericsson Mobile Companion MC218*, *Nokia Communicator 9110*)
4. Laptop PC: this includes all the sub-notebook sized equipment (e.g. *Sony Vaio*)

There are a few AP enabled smartphone products, which are commercially available between end 1999 and early 2000. Although the number of products with internet connectivity is initially very limited to a few types of terminals, by 2001 the majority of mobile phones produced will be AP enabled.

In order to easily enter information for SMS, e-mail and internet within a mobile phone environment, two different approaches have been chosen. Nokia is using Tegic's *T9* software in its *7110* smartphone that recognises the word to be typed when putting in the first letters. Motorola is using its own *Lexicus iTAP* system, with the same functionality on its *Timeport L7089* phone. Ericsson has developed an external keyboard, which can be clipped on to an existing phone

The smartphones coming with GPRS and 3G will also have all kinds of future functionality included which de facto lets them become a multifunctional consumer electronics device, such as a smartphone MP3 player, a communicator video viewer or a smart gameboy phone.

The *Siemens S25* has been developed as a AP enabled terminal. However, the product has been developed according to the WAP 1.0 standard, which is not used in Germany. Germany is Siemens largest market for mobile phones.

Laptops can be connected to mobile networks to receive and send e-mail, access corporate intranet data and browse the internet with speeds up to 14.4 Kbit/s on regular GSM networks and on 38 Kbit/s on HSCSD networks. They are increasingly becoming smaller and lighter, and the borders between these and top of the line PDAs are blurring.

Microbrowser

The microbrowser is a software product that is used to access the web from a handheld device. Content that has been created using WML is thereby accessible over mobile devices and networks. The two possible locations to position the browser are either in the phone or on the SIM card. However, the goal of microbrowser developers is to sell their own WAP gateways to mobile operators.

As noted already the microbrowser technology market is dominated by Phone.com and its *UP.Browser*, which is licensed for free to 90% of the world's mobile handset manufacturers and to *3Com's Palm*. The 2 major exceptions are Nokia and Ericsson. Nokia is using its own version of a WAP microbrowser in its smartphones and communicators (as in the *7110*), which it licenses to other terminal manufacturers. It also distributes the software via Spyglass, the US-based web solutions provider, to other handset vendors.

Microsoft is using its own proprietary product, which was developed especially for *Windows CE*. Microsoft acquired STNC in July 1999 mainly for its advanced microbrowser product, which is supplied to Symbian, Microsoft's strongest competitor for PDA/communicator operating systems. Microsoft is continuing to sell the microbrowser, but Symbian is urgently considering an alternative supplier, in order that they do not become wholly dependent.

Across Wireless (formerly AU-System Mobile) of Sweden, which is backed by Schroder Ventures, has worked with Finnish SIM card specialist Setec to put the WAP browser on the SIM card, so that it can be used by most standard GSM phones. This alternative is especially useful until WAP handsets are widely available.

German smartcard specialist Giesecke & Devrient (G&D) have developed their own wireless internet gateway browser, *STARSIM*, which is based on SIM toolkit and which can be used with GSM phones already. It is a temporary solution as it provides the potential to offer mobile access web applications today, which can be later transformed to WAP services.

The microbrowser needs to be on each handset in order to access WML content while the user is on the move. Durlacher believes that the microbrowser in itself provides no real competitive edge moving forward.

Bluetooth

Bluetooth is a low power radio technology that is being developed to replace the cables and infrared links for distances up to ten meters. Devices such as PCs, printers, mobile phones and PDAs can be linked together to communicate and exchange data via a wireless transceiver that fits on a single chip. We estimate that the unit cost will drop from Euro 20 today to below Euro 5 in a few years.

There are more than 1000 companies world wide supporting the technology through the Bluetooth Special Interest Group. After considerable delay, Bluetooth equipped devices will now be available on smartphones from approximately 2001 onwards.

Key applications of Bluetooth are the synchronisation of different pieces of equipment, e.g. mobile phone, PDA and PC, which will make it possible to perform only one single entry with any of the devices used. Additionally, data exchange (for example, with POS (Point Of Sale) terminals), ticketing or e-wallet applications for mobile commerce might also boost the success of Bluetooth. Since it has a throughput of about 1 Mbit/s, Bluetooth might also be used in wireless LAN applications.

Using Bluetooth, it will be possible to separate the transceiver unit of the mobile phone from the earpiece and the display. Thus, the transceiver unit could be in the belt buckle and the display in the watch with no wires needed.

We believe that although mobile commerce would be possible without Bluetooth, the technology is adding convenience for both mobile payment and security. Bluetooth provides some of the key functionalities to change a mobile phone into a "lifetool".

Smartcards

Smartcards, i.e. chip cards with a small microprocessor such as GeldKarte, Proton or Mondex, can have credit/debit functionality as well as digital signature or electronic wallet functionality. They are also capable of being used as a loyalty card or as a health record card. The SIM (Subscriber Identification Module) cards used within the GSM phone are



(miniature) smartcards as well. Their size and compatibility with the magnetic stripe card theoretically makes the smartcard an ideal carrier for personal information, such as secret keys, passwords, customisation profiles and medical emergency information.

Although many smartcards have been delivered to customers for other reasons (for instance as ATM (Automatic Teller Machine) cards) and not as a debit card for direct payments, there is ongoing speculation about the success of smartcards as an electronic purse. So far, there are about 30 million Proton-cards and 55 million GeldKarte circulating in the market. However, the smartcard for micropayments has not had any real success. In Germany, only 30% of all owners of a GeldKarte know that they actually possess one, because the small processor functionality is included in a normal bankcard and many customers have never used the electronic wallet functionality.

A common standard for smartcards is still absent. The 20 member strong OpenCard organisation grouped around IBM, Sun, Visa, Gemplus and Schlumberger have tried to push for interoperable smartcard solutions based on Java across many hardware and software platforms that are based on Java, but they do not seem to be overly committed to make it fly. Visa, for example, has also developed a proprietary solution, called Open-Platform that it is pushing independently into the market.

Additionally, there is an ongoing effort to develop the Multos-card, a multi-application card, which is claimed to be compatible with most international standards, such as GSM and EMV (Europay-Mastercard-Visa). So far the Multos card has not been compatible to the Javacard, yet another widely supported smartcard technology. The basic compatibility between the two has been agreed and we are awaiting the results.

However, too many standards have been created by the various vendors for both the smartcard operating system and the POS-terminal. It is our view that in the current situation, no one standard will gain a leading position. Technology is not the key differentiator; rather it is about business issues, such as customer take up and the availability of a common card reader.

Microsoft has positioned itself as a unifier of card operating systems by pushing its *Windows for Smartcards* to be launched in late 1999. The SIM card running on Windows will come with applications and downloadable applets such as *Windows 2000* log-on, internet access, e-mail, calendar, small address book, home banking, encryption, payment transaction, electronic signatures as well as the standard GSM requirements authentication, identification and portable storage.

We believe that, when WAP has reached critical mass in terms of penetration, applications and services will move away from the client and towards the network, so that there will be a thin phone client. It is very likely that the client's SIM card will continue to host the phone number, authentication, digital signature, identification, offline synchronisation, some favourite web sites and encryption.

Smartcards will continue to be a difficult market to forecast until a standardised true multi-application card is developed, which allows the incorporation of a number of different applications, including GSM-SIM and security applications, such as PKI (Public Key Infrastructure), on the same card. Ultimately, the mobile phone companies might create this kind of environment to strengthen their vision of the mobile phone as a "lifetool".

PKI

Security is a key enabling factor in m-commerce. Although GSM provides some improvements through the PIN (Personal Identification Number) when turning on the handset, through an authentication protocol between handset and network and through SSL (secure socket layer) encryption of voice and data, it is not sufficient for ensuring highly secure wireless commerce.

It is widely believed that smartcards will be the preferred way for gaining access to a secure system. The smartcard can be in form of a credit card or in the form of a miniature card, like the SIM card. It is possible to run a variety of applications on one single small SIM card.

Encryption is used to ensure confidentiality through a secret key in association with an algorithm. This produces a scrambled version of the original message that the recipient can decrypt using the original key to retrieve the content. The key must be kept secret between the two parties.

There are two basic methods, which can be used to encrypt a document: symmetric and asymmetric. With the symmetric method the same key is used for encryption and decryption. The problem is that the key has to be transmitted to the recipient of the message, and a third party could gain access to the key during this transmission.

Using an asymmetric algorithm, also known as public key methods, a set of two keys is used: a private and a public key. Information encrypted using the public key can only be retrieved using the complementary private key. With this system the public keys of all users can be published in open directories, facilitating communications between all parties. In addition to encryption, the public and private keys can be used to create and verify digital signatures.

Today, symmetric encryption such as DES (Data Encryption Standard) or 3-DES is most common. With the symmetric encryption method both parties have the same key, typically 40-128 bits. Asymmetric encryption becomes more relevant as it is a statutory requirement in some countries, e.g. in Germany by the Digital Signature Law. It is set to become more widespread in the future driven by the EU directive on electronic signatures of March 99, which has to be further translated into national laws. Within asymmetric encryption, each party has a key pair, i.e. a public and a private key with typically 1024-2048 bits.

The market leader in security for mobile commerce is Sonera SmartTrust, who has offered PKI (Public Key Infrastructure) for cell phones since early 1999. Sonera is co-operating with GTE CyberTrust, the US PKI specialist. PKI uses certificates, certification authorities, asymmetric encryption and digital signatures. Sonera has implemented PKI on a SIM card (manufactured by Finnish Setec) within the GSM phone, so that no additional smartcard reader is required. Other PKI solution providers include Baltimore of Ireland, who have a co-operation agreement with WAP gateway vendor Apion (acquired by Phone.com in October 1999). Full security is reached in PKI through:

- Digital signatures for authentication of customer and merchant
- Non-repudiation of the involvement in the transaction
- Strong encryption
- Integrity of the message
- Confidentiality

A new initiative, the Radicchio alliance has been launched in September 1999 by EDS, Gemplus, Sonera and Ericsson to promote PKI (Public Key Infrastructure) as the standard for secure wireless commerce transactions. The success of the initiative will largely depend on how well they can market themselves to the public and on how many other players they can get on board. 50 supporters by early 2000 is considered by them to be critical mass.

Security solutions are becoming increasingly integrated into application or platform offerings in order to increase reliability and decrease bandwidth-intensive add-on cryptographic software. JP Systems of the US is integrating Certicom's asymmetric encryption and *SSL Plus* technology in its wireless e-mail systems. Similarly Puma Technology, the synchronisation software provider, is also partnering with Certicom.

Brokat's *Twister* based electronic services delivery platform is also using electronic signatures, which are on the SIM card. Brokat of Germany, who is using a symmetric 128 bit encryption, has also created a PKI solution that includes mobile phones and is piloting it in Singapore and with Deutsche Telekom. HP's VeriFone division has also adapted its *VeriSmart* e-commerce software to support secure sessions with WAP based handsets.



We are convinced that after many years of PKI being 'just around the corner', fast take up or otherwise in the mobile market of Sonera's best-in-class encryption solution will determine if the technology will be able to finally reach critical mass.

Synchronisation

Synchronisation is a key technology enabling mobile commerce, because there will be demand for both web-centric and local applications on a PC or any type of mobile device. Synchronisation is the process by which identical versions of applications and data are maintained wherever and on whichever device the user chooses. So far in corporate purchases, management and synchronisation issues for mobile devices have been largely handled by individuals rather than the corporate organisation, because of the relatively low penetration rate of PDAs. However, in order to boost employee productivity, more companies will integrate communicators or smartphones into their corporate IT/communications environment. Mobile business applications, such as ERP, CRM, KM (Knowledge Management) systems or fleet management, are also demanding that particular data be resident on the client at any point of time, making mobile devices an extension of the corporate network.

For example, Puma Technology's *Intellisync Anywhere* software allows corporations to use remote and LAN (Local Area Network)-based synchronisation of *PalmOS* devices with *MS Exchange* and *Lotus Domino* as part of the business infrastructure. Motorola has initiated the *Starfish TrueSynch* initiative to advance synchronisation technology. The UK's Paragon software has developed *FoneSync* software that allows users to update the mobile phone's directory from a PC.

FusionOne has developed an internet synchronisation technology (*Internet Sync*) that facilitates anytime/anywhere information demand. The software provides the possibility to maintain files and contacts on the office PC, which are then converted and forwarded to a storage space on a web server. The space on the web server, however, is limited to 25 MB and only available in the US. From there, the data is automatically downloaded to other specified devices, such as a communicator, a smart phone or a home PC, when they are connected to the internet the next time. Additionally, a number of companies, such as Jump (acquired by Microsoft), Visto's Briefcase and desktop.com, are going to make the user's applications, files and data centrally available via the internet and accessible via any mobile device.

MOBILE LOCATION TECHNOLOGIES

The ability to locate the position of a mobile device is key to providing geographically specific value-added information that stimulates mobile commerce. Mobile location services may either be terminal or network based. The largest push for this technology is coming from the US. There, mobile telephone operators have been forced by the FCC to provide emergency 911 services by October 2001 in such a way that the location of the caller could be determined within a radius of 125 meters in 67% of all cases. ETSI has standardised the first three LFS (location fixing schemes): GPS, TOA and E-OTD in 1999.

GPS

GPS (Global Positioning System) is a system that consists of 24 satellites circling the earth in a particular constellation to each other so that several satellites fall within line of sight for any GPS receiver on Earth. Because the satellites are continuously broadcasting their own position and direction, the GPS receiver can calculate its position very exactly. Anybody can use the GPS system for free with an appropriate receiver. GPS has been developed in the US for military use, but from the beginning of the decade it has been usable (with lower resolution) for civilian purposes.

GPS requires additional equipment or some modification in the mobile device, so that it can become a GPS receiver. This technology is used in car navigation systems. GPS technology for mobile phones is being currently developed for example by SnapTrack and SiRF. GPS is already used in Benefon dual mode GSM/GPS handsets.

TOA

TOA (Time Of Arrival) technology requires larger network modifications and is therefore not very cost-effective. Rolling out TOA for an entire network is estimated to cost as much as 10 times the price of an E-OTD system.

E-OTD

The E-OTD (Enhanced Observed Time Difference) system works by using the existing GSM infrastructure to determine the mobile phone's location. When a user calls selected service providers, E-OTD simultaneously sends data indicating the phone's position. It works by comparing the relative times of arrival, at the handset and at a nearby fixed receiver, of signals transmitted by the underlying mobile network base stations. The E-OTD system overlays the existing mobile network. Suppliers for E-OTD solutions include CPS, Ericsson and BT Cellnet.

COO

COO (Cell Of Origin) can be used as a location fixing scheme for existing customers of network operators, but it is not as exact as the three other methods. It requires no modification to the mobile terminal, but the network operator has to do some significant upgrade work. While in urban areas COO might be sufficient to determine location fairly accurately, because the cell size is very small. In more rural areas, where the cell radius is larger, it might not be exact enough.

LFS Independent

SignalSoft has developed its own proprietary Wireless Location Services solution that can use any or several of the above methods to determine position. The software is installed on the operator's network and is able to combine the position with relevant content. SignalSoft has also developed a tool for provisioning the service and fixing the latitude against a defined zone.

CellPoint (formerly Technor), a recently Nasdaq listed Swedish start up, has developed yet another approach. It is handset based, and it works on the standard GSM network without any modifications. The solution needs only a proprietary server, and works on triangulation between the handset and the nearest base stations from both ends. Thus, the system is very quickly installable and cost efficient when compared with competing technologies. CellPoint's system provides a precision of 100 m in urban and 200 m in rural areas.

We believe that GSM positioning is a key technology, which will permit the distribution of highly valuable, localised information. It is very early to determine which of the technologies will lead the pack and dominates the market, because only one real commercial project has commenced so far (November 99), where CellPoint's technology has been supplied to Tele2 in Sweden. Because of the cost and time advantages we favour CellPoint in the short-term as a technology solution for operators, while in the medium to longer term, E-OTD might capture market share. However, this might only occur if CellPoint is not able to develop a sufficient granularity based on its existing approach or by integrating GPS.

The missing link will be to bring companies who provide the content together with geo-coded information, to make use of the technology. Applications using mobile location service technologies include fleet management, vehicle tracking for security, tracking for recovery in event of theft, telemetry, emergency services, location identification, navigation, location based information services and location based advertising.



MOBILE PERSONALISATION TECHNOLOGIES

Personalisation technologies are needed in order to develop a user profile, which can be recalled when the user is identified via cookies or username and password information. Proactive applications are expected in the mobile environment. The mobile user needs services that are able to learn from him or her either explicitly, i.e. through entered preferences, or implicitly, i.e. through behaviour.

Broadvision and Vignette are globally the leading vendors of personalised e-commerce applications. Both have only very recently (in October 1999) announced their interest in the m-commerce market. Broadvision is partnering with HP, Nokia, Phone.com and Brokat to create packaged applications and solutions around its *One-to-One* m-commerce platform. It minimises the need to navigate with your mobile phone and is configurable by either the network operator or by the subscriber.

Vignette has developed *StoryServer 4*, a system to manage customer relationships throughout the user's lifetime. It consists of a content management system and delivers a combination of profiling, personalisation and reporting services to create unique user experiences. These individual user experiences will be key in providing portal services to the mobile commerce user. Vignette is a member of the WAP Forum.

We believe that while personalisation technologies are already very successful in the e-commerce environment, they will be absolutely crucial in the m-commerce arena, where every additional click required from the user reduces the transaction probability by 50%.

CONTENT DELIVERY AND FORMAT

XML

The eXtensible Markup Language (XML) has the potential to be the standard language of e-commerce. XML is very like HTML in application and origin (in fact HTML becomes a sub-set of XML). They are lightweight meta-languages, languages used to describe the content and the structure of the data contained within. The primary difference between the two is that HTML is used to visually depict content on the web, whilst XML is designed to communicate the meaning of the data through a self-describing mechanism. If companies' information systems are XML compliant, data e.g. purchase orders, can be exchanged directly (computer-to-computer) even between organisations with different operating systems and data models. The drawback to XML is that it is not a data description language, rather it is a specification for creating data description languages. Partners must still agree on the meaning of the data they exchange.

XML allows information to be presented differently depending on the device used to access it, e.g. PC or smartphone. XML based microbrowsers are heavily promoted by the Microsoft camp, while the larger part of the market is supporting WAP products and services using WML instead. Microsoft promotes XML as an easier means to access data from HTML based applications, because only 10% of the data has to be changed. WirelessKnowledge, the joint venture of Microsoft and Qualcomm, has developed a product for converting HTML and *Exchange* applications to XML.

WML

WML (Wireless Mark-up Language), which is a rough subset of XML, has been developed especially for WAP. WML is basically to WAP what HTML is to the internet. WML is the format in which information can be read with a AP enabled phone and the built-in microbrowser.

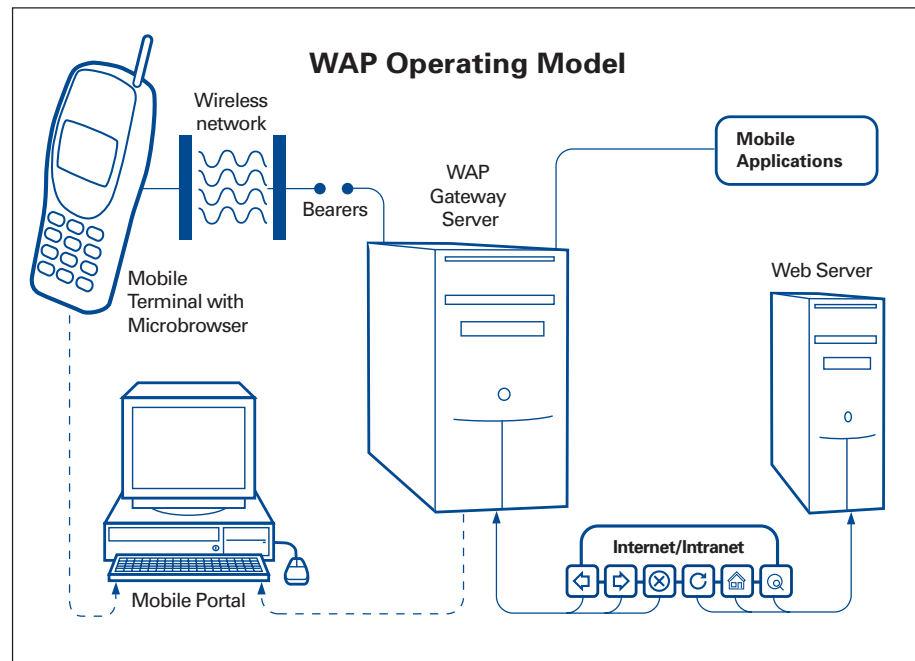


Figure 12 Source: Nokia, Durlacher

If a request in WML is made, it is passed to a WAP gateway, which in return contacts a web server with the content in standard HTML or preferably WML format. In case the content is in HTML format, a filter in the WAP gateway will try to translate the content into WML. Argo Interactive has developed *ActiGate* exactly for this, because the vast majority of content on the web is today only available in HTML format. While the HTML to WML translation is an interpretation of the site, most commercial solutions will require the site to be rewritten using WML from the ground up. The requested information is then sent back from the WAP gateway to the WAP client on any bearer service (e.g. SMS, USSD, HSCSD, GPRS).

VXML

Voice eXtensible Mark-up Language (VXML) is a standard being pushed by the VoiceXML Forum, driven by Motorola, AT&T and Lucent. VXML is aimed at enabling voice recognition for accessing the internet via a phone, wired or wireless. IBM has provided its speech recognition technology to further enhance the standardisation process.

IBM's *Viavoice Pro Millenium* software is already adding voice-activation to internet sites through AOL, Netscape and *Microsoft's Internet Explorer*, so that web content as well as e-mail can be read out loud by the PC. Nokia have allied with IBM to use their joint experience and technology in order to bring voice recognition to mobile devices. Microsoft has also invested heavily in speech recognition technology, snapping up Entropic and Lernaut & Hauspie. Motorola has linked up with Unisys to integrate its *VoxML* gateway with their Natural Language speech assistant in order to encourage developers to build voice access applications to the internet.

The frontrunner operator in applying voice recognition technology in a commercial application is Orange of the UK. Orange has introduced its *Wildfire* service in August 1999. *Wildfire* provides a humanised electronic assistant whom you can talk to to set up and access your voice-mail. The service talks back to the user and to external callers, and is being extended into a fuller unified messaging service.

The common problem with voice recognition technology is that the user has to train the device for a long period to recognise and interpret his or her voice. Shortening this time would help to develop the market faster. Voice recognition using highly limited learned vocabularies is already used in voice dialling phones today. We believe that voice



recognition will start to become a broader commercially available product by 2000 for use with mobile devices. Integration into smartphones and communicators will improve the usability for communications, PIM and m-commerce applications.

WWW:MMM

WWW:MMM (Mobile Media Mode) is a trademark to indicate that an internet based value-added service and a mobile device will work seamlessly together. The goal is to promote content that has been optimised for access via smartphones and communicators and the mobile internet overall. The trademark is jointly owned by Nokia, Ericsson and Motorola, who will license it to third parties for WAP-compliant products, content and services.

It is possible to run a site and browse other users' sites with a mobile phone under WWW:MMM. The user's homepage is his business card with all the personal details, address and contact information. Additionally, he can publish classifieds, express opinions or maintain a PIM (personal information manager).

WWW:MMM has the strongest backers in the mobile phone industry one could wish for, who do have a considerable interest in ensuring applications for their handsets are developed. However, WWW:MMM has not got so much attention yet as the market is flooded with new abbreviations all centred around the arrival of WAP. We believe that the trademark will need a strong marketing push, if it is to succeed.

M-COMMERCE ENABLING APPLICATIONS

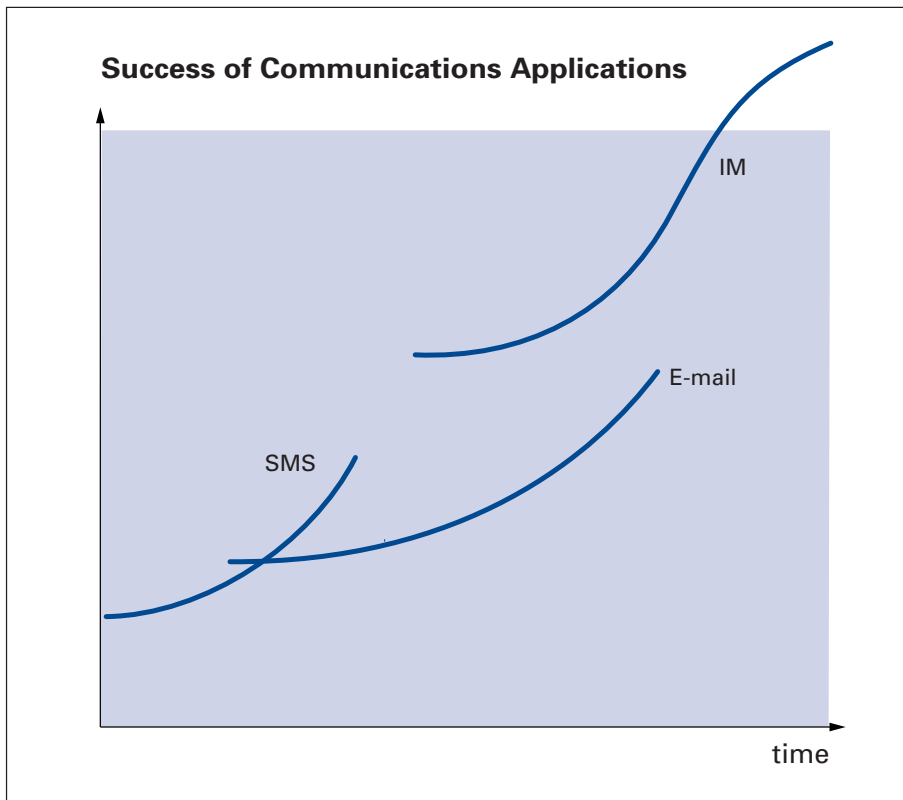


Figure 13 Source: Durlacher

E-MAIL

In our view e-mail is the killer application for wireless internet usage for two reasons: people generally understand the application and they need e-mail often as their prime communication link to stay in touch with their organisation or their friends and family. So far, e-mail access has been the key application for wireless data usage in Europe (together with internet access and SMS). There are broadly two different types of e-mail users:

Corporate Users

Until now e-mail has been accessed on the road by corporate users using a laptop, a GSM modem and a connected mobile phone. They are remotely dialling into the corporate network's mail server. This is by far the most frequent application used when remotely connecting to the internet/intranet. Current corporate remote access e-mail solutions are based typically on either Microsoft *Exchange* or *Lotus Notes/Domino* platforms, the dominating collaboration tools.

Alternatively, e-mail messages can be accessed by using a web-browser from other locations, such as hotels or internet cafes, to access (forwarded) e-mail from the corporate e-mail account. However, the highest convenience and accessibility would require a solution in which the e-mail service would be device independent and available on an anywhere/anytime basis.

E-mail access solutions from a mobile terminal will be offered by both, Microsoft with the *Platinum Exchange 2000* server building on the *Internet Cellular Smart Access* (ICSA 3.5 in Q1/2000) and Lotus with its *Domino* product, as well as European independent application developers, such as Dialogue Communications, Dynamical Systems Research, Satama Interactive (through acquisition of Seiren Solutions) and Peramon.

Peramon is providing a unique solution, called Lexicos, which allows the user not only to access e-mails in inbox and outbox, but to conduct a keyword search (using AltaVista technology) on her entire, fully indexed e-mail account. Thus, the e-mail system becomes effectively a personal knowledge management system, accessible from any web browser including a WAP terminal.

From Autumn 99, BT and Microsoft will be piloting (under the name "*Project Nomad*") access for business users via *Exchange* to e-mail, calendar and corporate intranet from a wireless, *CE* based phone or PDA in the UK and Norway. There are 2 second-tier phone makers, Samsung and Sagem, who are offering phones running on *CE* for the trial, but BT/Microsoft are also entering the hardware market and are going to jointly develop *CE* based smartphones and communicators. Thus, they are moving to a new position in the value chain and are redefining the rules of the wireless industry. A future alliance partner is likely to be AT&T for the US market, being BT's international partner. Microsoft's entry into the wireless market is very aggressive and it is targeted to where the future market will be created: in Europe.

In the US, Microsoft is using its WirelessKnowledge joint venture with Qualcomm to run similar trials. However, the Microsoft solution is not using WAP, but an XML based browser.

POP3 or IMAP 4 web based e-mail systems, such as HP's *OpenMail* are also used, but are less established in the business community. Web based e-mail requires only very thin clients and thus provides for easier it would provide easy WAP access.

Residential Users

Residential users are generally accessing e-mail either at one of the big portals (*MSN Hotmail, Yahoo! Mail, Lycos Mail, AOL mail* etc.) or at their local or preferred ISP. Choices for free e-mail accounts are virtually endless. E-mail makes the portal a particularly sticky application, as users are going back there to check their e-mails frequently. Some mobile portals such as Sonera or *Mannesmann D2* are offering e-mail services straight from the service launch.

Server-based e-mail via WAP would generate a key competitive advantage for any ISP or mobile operator at the current point of time. For example, Telfort Mobile has installed an e-mail gateway using SIM Toolkit from Microsoft (which was Sendit before the acquisition) in their network – this allows e-mails to be sent directly to the mobile phone as (phonenumber@carriersname.nl). UK based *Genie* (from Cellnet) offers similar services for SMS today.



In the US, on the other hand, the dominance of e-mail as a driver for wireless data is reflected in a variety of companies focussing only on that element. For example RCN Corporation, a regional ISP with over 500,000 subscribers, is promoting access to corporate e-mail on MS *Exchange* via the *BlackBerry* mobile e-mail terminal with PDA functionality, from Research in Motion. Paul Allen bought a quarter of the company, which is in total valued at about Euro 7.5 billion.

Other examples are the wireless ISPs GoAmerica or Alerta, which send e-mails to the wireless phone using an assigned e-mail address, as well as a copying them to a different e-mail address for free. Saraide offers wireless e-mail service based on Critical Path's platform. Intelligent Information Incorporated and Infinite Technologies have both developed solutions based on e-mail for the corporate and the carrier market.

MOBILE INSTANT MESSAGING (MIM)

Using mobile instant messages (similar to *ICQ*, *MSN Messenger* or *AOL's Instant Messenger* service on fixed networks) while being connected to the net (i.e. anytime, when using GPRS), will provide the opportunity for mobile users to check instant availability of people, communicate instantly on a non voice basis and use a chat-like environment for exchanging ideas and information. If a smart phone is used as the terminal to communicate it will probably feature some standard "canned messages", as it will be still complicated to enter text. Intelligent text recognition software, such as the *T9* function in the *Nokia 3210* or *7110* handsets, will ease the difficulty of entering words, by remembering earlier entries. Mobile messaging is a logical extension of SMS (Short Message Service), but it will not be limited in length to 160 characters and the message will be transmitted within a fraction of a second, i.e. near "real-time".

As a first, hefty push into that new market, Microsoft announced its wireless messaging product in September 1999, while AOL and Motorola have agreed in October 1999 to integrate AOL's *Instant Messenger* into Motorola's new smartphones and communicators. Thus, from Q1/2000 new Motorola phone users will be able to communicate with e-mail users at PCs instantly. In North America, AOL, Yahoo! and others are already integrating instant messaging into the wireless *Palm VII* device.

Messaging applications that are currently being developed include e-mail, chat, message boards, and access to internet telephony software, video conferencing, and on line games. These have the opportunity to become the dominant universal messaging tool.

The real advantages of mobile instant messaging will be utilised once the always on, always connected mode using GPRS network technology becomes a reality in the second half of 2000. It will be possible to send messages any time to the mobile device and check if the device is switched on. There are already companies developing applications around instant messaging technology, i.e. trading at a stock/options exchange. A very advanced application has been developed for example by Olympic Worldlink, who have developed a product, called *Mobile Futures*, which can transmit real-time prices and information to a PDA and provides instant communication/messaging capabilities under GSM.

We expect that mobile instant messaging will be very successful within exactly the segments of the market in which SMS usage has its stronghold today: the youth segment aged 15-25. Pricing of the service will be critical in order to convert existing SMS customers to MIM.

UNIFIED MESSAGING

Unified messaging systems (UMS) are a key application for mobile usage in future. Unified messaging is an emerging service that is crossing the boundaries between different communications media and is focussing on customer need rather than any particular technology. Theoretically, voice mail from fixed and mobile phones, SMS, e-mail, fax messages and instant messaging messages will all end up in the same mailbox. Unified messaging will enable the user to access the various messages with any one single

interface, i.e. PC, PDA, mobile phone or fax machine, independent on the original medium, which has been used to send the message. This requires the availability of text-to-speech and speech-to-text transformation technologies, which at this moment still seems something of a problem. The quality of the speech output is key to the success of UMS, and so far it has simply not delivered.

UMS has been offered for a number of years for both, corporate and residential customers, but only including a selection of the media described above. In the mobile world UMS is being offered by a variety of vendors, such as Comverse, Nokia, 2Communications and Dr. Materna and therefore comes in different flavours. Integration of WAP is key to the further roll-out of UMS.

UMS have been deployed by some operators, such as Singapore Telecom with *OneM@il*, or Telia with its *DoF* (Department of the Future) mobile portal based on the Oracle Application Server and Oracle web-based application software. Telecom Italia Mobile has launched its *Universal Number* product in November 1999, which is an advanced UMS product that sits on the Intelligent Network platform. It allows the user to send e-mails directly to a mobile phone without a PC. It is also possible to send audio as WAV files as attachments to e-mails in order to listen to voice mails from a PC. In Italy the penetration of mobile phones is about double the penetration of PCs.

The very advanced IP service application *iPulse* from OZ.COM and Ericsson, instantly connects computer, PDA and fixed or mobile phone. Additionally, it provides PIM and web collaboration functionality. We believe that unified messaging is set to become a mainstream application within two years.

MOBILE CHAT

Mobile SMS chat has already been offered as a service for about one year in some European markets, such as Finland, Germany and the UK. Chats are based on communities of interest between like minded people. The number of possible communication links increases by an order of magnitude when the number of participants double. Thus, the stickiness of a chat group theoretically increases significantly as user numbers grow.

Chat is a very popular application in the PC based internet world especially among the 15 to 25 year-old user group. This same segment of the market also constitutes the bulk of SMS users. Thus, linking those two applications is a natural development. Dr. Materna of Germany has developed a chat application that allows the combination of online, videotext and SMS into the same service and the user can use any platform to participate. Another vendor of an SMS chat platform is WAPIT of Finland, key supplier for Radiolinja, the Finnish GSM operator. With the arrival of instant messaging via mobile devices, we expect that chat will move to this new platform, and will be both faster and more cost efficient.

MOBILE VIDEOTELEPHONY

The video telephony concept has been developed by handset vendors as a potential application of mobile internet despite the unsuccessful experience in the fixed telecommunications market. In no European market has the penetration of videophones ever taken off and reached critical mass. Correspondingly, it is in our view very unlikely that we will see this as one of the key applications in the mobile business. We believe that videotelephony will be only a niche market product for the first years of the next decade.

MOBILE PIM

Some form of scheduling functionality, such as calendar, address book, tasks and journal, is included in every PDA and in any *Office* type or groupware software package. Most of these are device-oriented, while the Personal Information Management (PIM) evaluated here does basically the same, but runs on the net and is thus device independent.



The advantage of the net version is that it can be accessed from any web-browser, whether it is a PC based or a AP enabled smartphone. Changes on the PIM are always made in real-time mode, thus helping work-groups to stay closely in touch, even when out of the office. The operator can actually host the PIM functionality for both corporate and private customers.

Mobile accessible PIM-solutions have been developed for example by TimeSystem, the former European market leader of the paper-based day planner, GIN (acquired by Saraide.com), Future Internet Technologies, and Seiren Solutions (who was also acquired during 1999). In the US, there were about 10 PIM players, out of which 5 were bought up including When.com (by AOL) and Jump (by Microsoft).

We believe that a mobile accessible PIM is an interesting addition for a complete portal, useful for those people who do not always carry their PDA or communicator with them. Availability, security and ease of synchronisation with existing legacy systems (*MS Outlook, Lotus Notes*) and existing PDAs is key so that the data has to be maintained only once.

CONSUMER M-COMMERCE APPLICATIONS

In this report, we analyse m-commerce applications first in a consumer context and thereafter in a business context. This section covers consumer applications. The following diagram indicates when applications will be commercially available in Europe and which technology is the particular enabler.

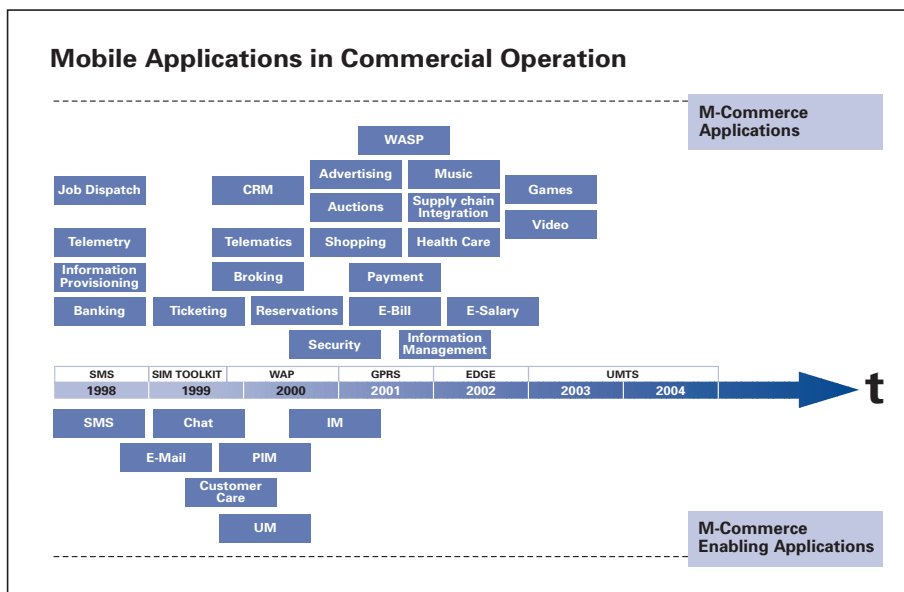


Figure 14 Source: Durlacher, Veiba

MOBILE FINANCIAL SERVICES

Financial services are a key commercial driver for the mobile commerce market in Europe and beyond. Retail banking and stockbroking markets are in the midst of major industrial restructuring resulting in significant M&A activity and the online dimension is accentuating this. Taking their online activities to a mobile device opens a new service channel for the financial institutions. In a recent survey by Nokia, looking at which application types various parts of the market might demand and when, Mobile banking was the top application demanded by more than 85%.

Mobile Banking

Mobile banking is a subset of online banking, a service that is being offered by 94% of all banks in Europe in 1999. The motivator for mobile banking from the bank's perspective is to have an additional distribution channel and to further cut costs, as every transaction on the internet, fixed or mobile, is saving money on the bricks and mortar operations side.

Based on an existing back office online banking operation, mobile banking can be deployed in a straightforward manner. It requires the elements in the form of a private information service, SIM Toolkit or WAP support and security.

The services mainly considered for offering through mobile banking are:

Public Information

- check exchange rates
- check interest rates

Private Information

- check account and credit card balances
- administer credit lines
- check interest earned on deposits
- check last transactions

Transaction

- transfer funds
- pay invoices
- apply for credit line

The simplest mobile banking solutions can be pull based via a voice call to an IVR (Interactive Voice Response) system or via an SMS request. Alternatively, the service could be push type, thus sending information on an event basis, depending on a certain time or value. All information is currently typically sent via SMS over GSM networks. Interestingly, mobile banking services can generate some additional revenues where banks are sharing in operator revenues generated by the SMS enquiries.

There are more than 30 mobile banking services already in place world wide, and a few have reached mass market status, such as Czech operator Paegas with Expandia Bank and Merita Nordbanken of Finland/Sweden.

The first mobile banking service was started by Merita, the innovation leader in mobile banking, which allowed their customers to make bill payments via GSM as early as 1992 and SMS-based balance checking and transactions from 1997.

In the UK customers of *Barclaycard*, Barclay's Bank and Cellnet have conducted mobile banking since 1997. A special handset with a bank direct dial "*Barclay button*" allows the users to receive mini statements, check credit card limits, balances and next payment days. Apparently this led to more than 150,000 very loyal customers. The Woolwich Building Society has also announced mobile banking plans in the UK.

Paegas has developed multi-banking support, but each subscriber can only use one specific bank. The SIM Toolkit solution from Giesecke & Devrient, which is based on point to point SMS service, uses symmetric encryption (triple DES). The customer can actually download a bank's specific menu structure to the phone's SIM card. The mobile banking solution is the main driver leading to the current 20% penetration of customers using mobile commerce.

Elsewhere SIM Toolkit based mobile banking solutions are now offered by the DVG, a German savings bank association, German direct and online bank 1822direkt.

On arrival of WAP phones, Merita launched a commercial WAP banking service in October 1999 after completion of an 8 month trial period in partnership with Nokia.

Deutsche Bank, the world's largest financial services organisation, has also decided to move to WAP with the help of Nokia as a full solution provider, i.e. also as a systems integrator. Svenska Handelsbanken has teamed up with IBM to launch a WAP based mobile banking service in Q1/2000. Thus, we believe that the future is WAP banking rather than SIM Toolkit banking.



Mobile Broking

Mobile broking is a killer application for mobile commerce. Location independent, real-time information about a share price reaching a particular stop mark and the possibility to act on it provides a very high value to many stock traders, private or professional. Shares exceeding certain price points could trigger messages asking whether to buy or sell. In the US, many online brokers are already offering mobile trading via cell phones or *Palm VII*.

Traditional stockbrokers are moving increasingly online and new online brokerage firms are being established all across Europe, such as the First E-Bank (which is teaming up with Wit Capital to combine banking and broking in Europe). Competition is becoming fiercer in an online world, but mobile broking provides a new differentiator and increases customer loyalty. The online trading commissions will still be charged, but trading volumes are expected to be higher as clients have more opportunities to trade.

Mobile broking provides the following key functionalities:

- receive alerts about price-movements
- receive message when order is executed
- check quotes
- manage portfolio
- buy and sell stocks, options, mutual funds, other financial instruments
- browse and delete existing orders

Merita-Nordbanken of Finland and Sweden is already experiencing increased trading volumes through online brokerage. Today, more than 57% of their stock orders are done online. Therefore, Merita has prepared well to launch in November its WAP brokerage service. Also Leonia Bank and Oko-Bank, the two main competitors of Merita, are betting on WAP. And the leading online brokerage in Finland, eQ-online, is involved in a pilot with Sonera.

Delivering financial information regarding the stock market in a real-time or offline mode is a very useful aspect of mobile broking, but it still is missing the transaction capability. In order to conduct a transaction based on the information, the investor would still have to call his broker. For example, in Germany Dr. Materna in partnership with Teledata real-time share prices, offers exchange rates and lists of share prices, portfolio management tools and so on. Multichart is offering its *KISS(me)* Broker product, which is augmented by an additional news service. In the US, Stock Smart is offering more than 400,000 web pages with financial information that can be customised and sent on an event basis to mobile devices.

When it comes to transactions however, many mobile brokers seem to rely solely on the standard GSM SSL encryption, without any advanced features and guarantees. PKI must be standard to ensure secure stock trading.

While an average PC online share trade takes about 5 minutes, Fraser Securities of Singapore is experiencing an average trading time of only 2 minutes for mobile devices. The expectations of the mobile broking service are high, but it is believed that the payback period (in terms of ROI (Return On Investment)) for the S\$500,000 investment is only a few months. The take up of the service within the first 4 months of operation was so high, that more than 20% of all the online trades were done via mobile phone, although only one particular mobile phone type could be used with a microbrowser equipped SIM card.

We believe that mobile broking will be a regular way to trade shares in the whole of Europe within the next five years. Many more people will own a mobile phone than a PC by that time, and a new level of convenience and timeliness of decision making can be reached. Thus, the application will help to drive mobile commerce as a whole.

Mobile Cash

Mobile electronic cash refers to loading cash onto a stored value card via the wireless network. It is also referred to as mobile ATM or mobile phone cash machine. The solutions

so far being piloted all use Motorola's dual slot *StarTac D* mobile phone to authenticate and verify transactions. The phone is thicker than the regular model, because it has space for a full sized smartcard reader at the back. The other manufacturers have not developed a dual slot phone, but some are experimenting with a smartcard reader somehow included in the mobile handset.

In one of those trials, Visa in the UK has been experimenting with a debit smartcard called *Visa Cash*, to which the cash can be loaded, while Barclaycard has supplied the card and is providing the banking infrastructure. The trial was conducted over the BT Cellnet network in early 1999. Smartcard manufacturers, such as Gemplus and De La Rue (acquired by Oberthur in September 1999), have been involved using SIM Toolkit to ensure the authenticity and integrity of the transaction. In a trial in Singapore that will be launched commercially at the end of 1999, local debit cards can be reloaded with the same technology.

We believe that these trials are an interesting playground for seeing how the different technologies work together, but dual slot terminals are unlikely to become widespread in the market, for several reasons: the phone would be thicker and heavier, and smartcards for micropayments have not worked so far. Moreover, a smart card reader on a mobile phone might not be robust enough to survive external impact on the handset. BT Cellnet has already officially announced that dual slot phones will not be introduced commercially for the foreseeable future.

Mobile Payment

In August 1999, France Telecom launched its *Iti Achat* service for purchasing via the mobile network on a trial basis. It was launched as a mobile commerce pilot, but is in fact more a mobile payment service. It is based on a dual slot Motorola *StarTac* phone with a smart card reader that allows payments via Cartes Bancaires (CB), the bank card supplier group. While they have already signed up some interesting merchants, the process is still far from a viable commercial mass-market initiative.

After the customer has ordered the product by phone, internet or *Minitel*, the merchant will send an SMS message with the relevant price. Then the customer must insert his CB card into the second slot, enter a password and the transaction data is then transmitted to one of the participating banks. The service is planned for commercial launch during Q1/2000. While the service provides some additional security in comparison to just giving the credit card number over the phone or via the internet, we do not believe in the future success of this type of solution. Dual slot phones are unlikely to become mainstream products and the solution does not fulfil the basic requirement of making the user's life easier.

A more advanced mobile payment solution is realised by Sonera, formerly Telecom Finland. It all started with the famous *Coke* vending machine, which has been converted into a *Pepsi* automate since, from which a soft drink could be purchased with a GSM phone. Currently, it is possible to use *Pay-By-GSM* for a variety of low-priced products and services such as passport photos, copies, golf balls, jukebox, toy car ride, shoeshine machine and car wash.

There are three ways in which customers can purchase a product or service from a vending machine or the internet using a mobile phone:

- Dial a premium rate number (0900) which has a call charge equivalent to the product price.
- Dial a prefix plus a premium rate number to indicate that the product should be charged to a different bill (important for users of corporate mobiles).
- A pre-standing agreement for credit card payments is put in place. For authenticity, a PIN has to be entered at the time of purchase.

The role of Sonera is that of a clearinghouse, (which collects the money from the users and credits it to the service providers) and that of a network provider, who is generating additional traffic. Ericsson and Unisource have also piloted the use of vending machines in Stockholm, but these did not become as popular as Sonera's trial.



The first showcase Bluetooth vending machine has also been developed by Sonera in 1999, which allows the purchase of soft drinks, CD covers and candy bars with a Bluetooth-equipped mobile phone.

We believe that mobile payment will have an enormous potential, especially when using Bluetooth technology. But this technology must be pushed by the Bluetooth technology and handset vendors, since mobile operators have no additional call revenues, since no calls are established via the network. However, the operators might take over the clearinghouse and billing function instead, thereby switching their role in the value chain towards content.

Finland has produced another innovative payment solution, which is today being used for "traditional" internet purchases, but which will be also available towards the end of 1999 via WAP terminals. It is an SSL-based solution (thus only standard GSM security), which is offered by Merita-Nordbanken using its established *Solo* brand to pay directly over the (mobile) internet to 700 merchants from your bank account just by entering your username, password and a TAN (i.e. a one time transaction number). Key for the success of this payment method is that the technology functions according to users' habits, it is only adding an additional distribution channel at no additional cost for the user and it does not try to change the user's habits. Finnish banking customers have been using this method since 1984, when online banking was first introduced to the market.

Again, Merita-Nordbanken, Nokia and Visa are experimenting with the *EMPS*-phone, the *Electronic Mobile Payment System* mobile phone, which is based on a dual SIM concept for the *Nokia 7110* WAP phone. A second, semi-permanent, multi-application, minisize smartcard, that is a Visa credit and debit card as well as a Merita bankcard, is inserted into the mobile phone. One of the major difficulties Visa has with this solution is that the logos are only displayed on the screen. Bluetooth shall be used to make local payments via the shop POS equipment, while other payments can be made over the internet. Major problems retarding the uptake of the solutions are that there are no dual SIM WAP phones on the market and that there are no POS terminals for smartcards with or without Bluetooth capability available.

KLELine, a subsidiary of French bank Paribas, has taken up a role as trust centre for online payments. They provide the user with a virtual wallet for their mobile phone that can be loaded from his Visa, Mastercard or American Express card up to USD 100. The wallet can then be used to pay for mobile commerce transactions, such as premium content or any other goods offered.

Confinity, a Silicon Valley start-up, is building a service called *Pay-Pal*, that allows users with a handheld device to make payments to anyone else with a similar handheld device – allowing the settling of debts, borrowing of cash or splitting of bills without exchange of cash. In order to use the service the user of *Pay-Pal* has to register his credit card details on the Confinity web page and download the software. The free service allows the beaming of money from one mobile terminal via infrared to another. Only when the sender goes back online again, the amount is actually dispatched. The business model is based on having the money sent into Confinity's account for a few days and Confinity using the interest from it. The company received backing among others from Nokia Ventures and Deutsche Bank Tech Ventures. Currently it is available only in the US and only with a *PalmPilot* PDA. *Pay-Pal* can be seen as a pre-Bluetooth application, as it only uses infrared. It might be upgraded in 2001, when Bluetooth chipsets are widely available. Bluetooth would facilitate payment at the point of sale, but it requires the technology at both ends and the capability to load mobile phones with cash or to direct debit a bank account.

Solving the payment issue in mobile commerce is key for the future uptake of the industry. So far no standards have emerged, but, for the time being, it seems most feasible to use existing payment methods such as credit cards, direct debit, etc., and transferring those to the m-commerce market place. However, security issues remain, as do the demand for convenience and micro-payments. The ideal solution to us seems to move the payment application to the mobile device itself and use the handheld to pay either at the POS via

Bluetooth or over a distance via the internet involving some kind of security measures such as PKI. Mobile operators will try to position themselves as key providers of the mobile payment solution, which will in our view lead to partnering with and ultimately acquisition of banks or a banking license.

Mobile e-bill

In Finland you can already receive electronic bills to an e-mail address or to a mobile phone, e.g. from your telephone company, which can be paid via semi-direct debit from the handheld terminal. Thus, no paper invoice is sent any longer.

This will cut costs significantly for the bill issuer saving in both production costs and postage. For the user, mobile e-bill will significantly reduce the effort required to pay bills to trusted parties. The security issue in respect of the digital signature must be solved in order to roll out this service to the entire market.

Mobile e-salary

Sonera employees have to choose today whether they would like to receive their monthly payslips via e-mail or via SMS to their mobile phones. Paper payslips will no longer be produced and distributed to employees by default. The cost cutting effect is significant, because the administration work for physically distributing 9,000 payslips every month as well as printing are no longer necessary.

MOBILE SECURITY SERVICES

The mobile phone with its integrated SIM card is an ideal bearer for the private key digital signature of a PKI system. Thus, the mobile device can become a security tool, for example for secure payment in e-commerce and m-commerce.

The wireless terminal can function as a security device for gaining access to buildings in at least two different ways. First, access could be via using the GSM part of the mobile phone and second, Bluetooth technology could be used as the authentication mechanism.

Sonera in Finland is using GSM already today to open the door to the corporate parking garage. The employees can dial the garage door when they are still some meters away, so that the door will open as they arrive. A back end database administers the mobile phone numbers, which are permitted to use the service. GSM is used in this case instead of a purpose-built infrared sender, which would create significant hardware costs, if all the employees were equipped with such a device.

As soon as Bluetooth technology becomes available in the first handsets in 2001, it will be an ideal way to establish entrance permissions for a given phone. Similarly, the mobile device can be used as an identifier for permission on Pay TV systems.

MOBILE SHOPPING

Mobile extends your ability to make transactions across time and location and creates new transaction opportunities. It is important to note that only a part of the purchasing process is conducted with the mobile terminal. The basic point is that you need to know what you want in advance of making a mobile purchase. Moving forward, it seems most likely that a shopping list might be created with a web interface, which may then be executed from a mobile.

At the current stage of technological development the customer must ideally be faced with a one-button purchase experience for mobile shopping. The purchase suggestions will often be based on the user's past behaviour patterns.



Mobile Retailing

There have been a number of network-based services with respect to mobile retailing already available but there has been little success so far. A value-added GSM service, such as *D2Blumen*, a flower ordering service of German Mannesmann Mobilfunk in conjunction with Fleurop, the world wide network of flower shops, makes it possible to get connected to a call centre and order via credit card.

It is an interesting application to use a smartphone to order pizza from a delivery service; this might be even more appealing than ordering the pizza via internet, because it takes a long time to boot the PC or a PC might not be available. The hurdles for a fast uptake are of course that microbrowser phones are not spread in the market and applications are missing. For example, pizza delivery services have so far not been fast to move to a web-based model. Mobile commerce combined with location identification creates new value, for example, when ordering a taxi or a pizza the vendor can automatically know where the service is to be delivered.

However, we believe that there will be a large space for e-retailers to become m-retailers, when the personalisation and location issues are well addressed. Books, CDs and groceries are often items, which the user knows well and where he needs just a tool to make a purchase. The purchase will be made when the user has spare time, independently of the shop opening hours and physical location.

Mobile Ticketing

Mobile electronic purchase or reservation of tickets is one of the most compelling proposed services, because ticket reservation/purchasing is hardly a pleasant expertise today. Either one has to go in person to a ticket booth, or has to call an agency or the outlet. Calling outside opening hours means having to go through a lengthy IVR (Intelligent Voice Response) system.

It is clearly more convenient to select and book tickets for movies, theatres, opera and concerts directly from the mobile device, because often the decision to purchase is made while outside or on the move among friends.

This is one of the first WAP applications being seen in many markets. It will take some time until the process is fully automated, because even if today many movie theatre schedules are on the web, this does not mean that it is possible to make a purchase or a reservation there and then. In most cases, due to lack of back end integration, one still has to call to book the ticket. A first step on the way to full automation of the transaction would be to offer one-button dial to the ticket issuer.

The travel market and especially the frequent business traveller market is likely to be an early WAP growth market. Using a WAP handset, train, plane, bus and boat tickets could be booked in a similar manner to movie tickets. The argument goes that mobile commerce will be the driver of market growth in this arena, rather than a phenomenon, which lags behind wireline commerce growth

The mobile device must be intelligent enough to be able to learn that I go home every weekend to my family and I always need a ticket for the same train. Thus, the mobile portal should suggest this automatically as a default option.

A mobile ticket shop installation is already in place for commercial operations in Norway by Telenor Mobil with Across Wireless' WAP platform for both, cinema and theatre tickets. The subscribers can even make payments for the tickets with their GSM phone. A ticketing application trial has also been developed in Germany by Intershop and Danet consultants (part of the Deutsche Telekom group), which includes reservations in the first phase, but is likely to be extended to film reviews and mobile payment as well.

We believe that ultimately, the tickets will be downloaded onto the mobile device and the device will communicate with the check-in counter at the movie theatre or at the airport via Bluetooth or infrared. Some airlines (such as Lufthansa, BA and SAS) already provide

their frequent travellers today with the possibility of electronic ticketing, that is they use their frequent traveller smartcard to identify themselves at the airport to get their boarding pass without ever having held a real ticket in their hands. Why shouldn't the mobile phone also be used to identify the owner via Bluetooth or infrared? The loyalty application, i.e. the entire frequent flyer program details, should be placed ideally in a way that it is easily accessible via the WAP terminal.

The problem is that a lot of transport operators and airlines have legacy systems in operation that do not support electronic ticketing and therefore mobile ticketing either. Thus, the existing IT-infrastructure is one of the greatest handicaps in the move to optimised m-commerce business processes.

Bluetooth will be able to take over many functions and it seems likely that it will be also used for example as a touchless ticketing system for public transport ticketing or for paying toll on streets, since it allows communications to take place directly from machine to machine.

We believe that the airlines will make the first significant push into the mobile ticketing space, because they do have already some experiences in electronic business and they have lots of costs to cut. However, it will take years of passenger education before we see mass uptake of the service. Taking the example cited above, e-tickets make up probably no more than 1-2% of tickets, which are issued e.g. by Lufthansa.

Mobile Auctions

Auctioning is gaining significant page views on the internet as more and more auction sites are popping up for B-to-C, C-to-C and B-to-B. Moving into the mobile environment seems to be a natural extension of the existing business models. The base proposition is that bidders want to continue to participate even when they are not in front of a PC.

A AP enabled smartphone, a communicator or a regular SIM Toolkit mobile phone could be used to receive an SMS message about the latest bid at a pre-set stop mark combined with the questions to bid higher or not. Thus, the bidder does not even have to be online, she could still participate in the process in an almost real-time mode. However, SMS is not too time sensitive, such that the delay might be at times higher than acceptable. We believe that a solution might be the use of USSD technology over WAP terminals, because the interactive session will be in an online mode.

Once instant messaging and instant access to the internet over GPRS have been fully implemented into wireless devices, participation in the auction could be within a real session, but with costs to the user being generated only when data is transmitted.

As one of the first attempts to move into that space, Xypoint and Wireless Services Corp. have joined forces to create *WebWireless*, a mobile commerce platform. It works in conjunction with a standard web browser, where a notification parameter is turned on, so that an SMS alert can be received from the user for online auction prices. Then the user must actually call an IVR to articulate his intended action. This service will cost up to Euro 10 per subscriber per month. BTCellnet has announced that it will offer mobile participation in auctions on its *Genie* mobile portal from 2000.

We believe that the auctioning model will expand into the mobile space very quickly, once eBay (who is launching already a co-branded auction pager in the US), QXL and others begin seriously integrating the additional distribution channel, because wireless devices provide the ideal environment for auctions. Mobile devices can overcome the hurdle of being tied to a fixed location, while the user is able to be responsive in an almost real-time mode.

Mobile Reservations

Mobile reservations for restaurants and hotels has been one of the most featured applications in mobile commerce, since the prospect of easily finding a restaurant or hotel that suits personal taste and fits the relevant criteria at least is intuitively very appealing.



Especially as a location based service, mobile reservations become a valuable application for the business or leisure traveller.

In the future scenario, using the smartphone's or communicator's microbrowser, the restaurant item can be selected from the mobile portal and particular choices can be made, if the user profile is not already making a suggestion based on past choices and the pre-set parameters. Once down to the preferred restaurant, the user connects directly to the web site of the restaurant (in WML format ideally) to make his reservation.

The problem, currently, is that although there are a few online restaurant guides operating, not too many restaurants or hotels have a web presence. The second best choice would be to get their telephone number and address from a Yellow Pages directory or restaurant guide for the next few years, call the number and gradually move to the web-based model. In order to reverse the payment structure so that the call initiator is the vendor rather than the customer, RealCall and Argo have recently announced a strategic alliance to develop a solution that permits mobile phone users to access a web site from their phones. The users can receive simultaneous live telephone calls via digital call-back from the relevant vendor.

Thus, the restaurant can be called up for a reservation or, using geo-coded location information to indicate the exact location of the place, the mobile handset can tell how to get there. A push service is also likely to be available soon, which is basically a form of mobile advertising. Once a person enters a particular area, an SMS or IM (Instant Messaging) might be generated to indicate that there is a particular type of restaurant close to his or her actual position. The phone would ideally indicate directions from the current location of the user to the restaurant using services such as those piloted by CPS: "Where am I?" and "How do I get there?" based on positioning technology.

At the back-end, the information from the restaurants and hotels would be available in different formats. It could be in the online Yellow or White Pages or in some form of online City Guide. However, in order to leverage the location information fully, the data must be in a geo-coded format. Companies such as Saraide.com (through the acquisition of Dutch GIN), InfoSpace (US) or Swedish start-up CitiKey are supplying or intend to supply their information in this format.

Notwithstanding the limitations as indicated above, we believe that a usable location based service could start to be available by the second half of 2000, once smartphones begin to appear with integrated positioning modules deployed by the operators and vendors.

Mobile Postcard

This wireless picture messaging service lets the users send digital images from a regular mobile phone, a WAP phone or a mobile portal on the internet. Sonera has developed this service, which lets the receiver obtain a real postcard (via regular mail), a virtual postcard or an e-mail postcard. A digital camera must be used to make the photo. Small digital cameras are already being integrated into Sony handheld computers.

Users of this technology could be private customers, who want to send their own photos as postcards to friends and family, photo journalists, builders, surveyors or other professionals who need to send images back to the office. We see this application as a perfect use of mobile technology with integrated consumer electronics, but the impact on the market will be rather limited.

MOBILE ADVERTISING

There is a widespread opinion, that mobile internet will not be as dependent on advertising revenues as the wired internet. Among the justifications for this view are that mobile phones currently have a very small user interface and that graphical visualisation on the screen is very limited.

Up to now, mobile advertising has been carried out only on a very limited level, for example by offering a free cell broadcast channel delivering news – the name of the content provider is always distributed as well. However, we argue that advertising on mobile devices, whether a smart phone or a communicator, will continue to have a strong business case, because it is the dream environment for every marketeer.

It is possible to mass customise a mobile phone for particular user requirements, which then in return would allow one-to-one marketing. It is business critical to market to the individual consumer through very pinpointed and localised messages.

The conditions for one-to-one marketing are ideal using the mobile device. The mobile operator or service provider has not only all the demographic data of the subscriber, but also has been able to build a data profile with lots of information about that user's calling patterns. And there are going to be plenty of mobile subscribers around the globe, about 1 billion by 2003. Additionally, by providing a mobile portal the network operator can get even more information on the subscriber, as he is requested to input his or her preferences and information needs, so that he will receive personalised, and thus more valuable, information. Finally, with the use of mobile positioning technology, the network operator can identify fairly exactly what is the location of the subscriber.

All of these factors combined would create the ultimate marketing tool. Since most business transactions are local and the mobile device is the only tool that enables location-dependent services so far, personalised advertising via the mobile device seems to make sense. Vendors can reach their target customers when they are near the actual outlet.

For example, people close to an Argentine steakhouse receive a message about a lunch special. Those people have been selected because they are physically near to the location of the restaurant and because they have selected Argentine food as one of their favourites on their mobile portal.

Today, mobile advertising is carried out using the short message service. In the near future, the RealCall/Argo solution may provide a way for the advertiser to actually call the mobile subscriber, while he or she is near their site. As we move from simple mobile phones via AP enabled to GPRS and W-CDMA smart phones and communicators, the potential for advertising that includes audio, pictures and video clips on a colour screen is increasing. Monochrome pictures can be displayed and sent on a *Nokia Communicator 9110* today, while Samsung has integrated an MP3 player into one of their phones and Sanyo has already developed a mobile videophone.

As the functionalities of the phone are extended with the arrival of the new protocols, so the bandwidth available over mobile networks increases. Looking at GPRS with an "always connected" mode, very targeted ads could be sent easily. Moreover, advertising is also possible on the mobile portal, which is on the web and managed usually from a real PC, but accessed by a mobile device.

The revenue model to be applied is likely to be slightly different to a regular internet advertising model. It is more likely to be like Cybergold or Webmiles, where the viewer is paid for accepting and watching an ad. Technology providers of mobile location services, e.g. CellPoint (formerly Technor) of US/Sweden, are keen to get themselves into a revenue sharing agreement with network operators, because of the sheer size of the market. So far the concept of using the mobile device as a media channel has not been exploited, perhaps because web advertising is driven from the US while mobile communications is driven from Europe.

Sunday (the mobile service rather than the day of the week) in Hong Kong is one example of a mobile advertising service which is already operational today, but it works in a pull rather than push mode. For example, *Sunday's* subscribers can call a number and receive special offers by phone from shops in a particular shopping centre when they are actually inside the shopping centre in question. Many of *Sunday's* customers are happy to receive an ad via the mobile phone as a voice or text message for the chance of getting a bargain. It would be interesting to discover whether local cultural dynamics have any impact on the choice of technology deployed when building a commercial mobile advertising service.



Over the next 12 months during the period when the mobile market for advertising is emerging, it is important to understand that this is primarily a pre-marketing tool. Content partnerships should be built to help develop the new media distribution channel. Highly targeted messaging can follow after the users have got used to the medium for receiving information services and alerts. Once the basics have been identified and secured one can then roll on the bells and whistles.

The key question to be solved in the future remains: who will be delivering the advertising – the mobile operator, the content provider or the mobile portal owner?

We believe that if the mobile operators succeed in becoming the portal player of choice, the advertising revenues will remain with them. It still has to be seen whether mobile operators, who have hitherto focused on network roll-out and voice might become serious value-added content aggregators, i.e. portal players. The existing portals have the know-how of how to run a portal, but they do not have all the subscriber data, such as billing address, demographics, calling patterns and locations. This is information that only the operator has accumulated.

However, it is also possible that the content provider will use a direct channel to the customer, for example via SMS. In Finland there is a trial from eQ Online, the online brokerage, who advertises using SMS messages with stock prices or exchange rates from Kauppalehti, the leading business daily. The solution has been put in place by 24/7 Europe, the advertising professional network. It is using a telephone number and a direct link for WAP users to respond to the ad. While no WAP phones were on the market during the trial period in October 1999, the hotline response was overwhelming.

Yet another move into mobile advertising has been made by Wired Digital in the US. It has placed banner ads for Hilton Hotels to users of Palm PDAs via AvantGo's *PalmPilot network*, which lets people download news. The reach was no more than 6,000 users, but the demographics were almost ideally fitting the mobile executive. Content managers, such as AvantGo, are just starting to open up to advertisers, but their business model is likely to evolve into sponsoring and advertisements as revenue sources.

We conclude that mobile advertising will become an important pillar of mobile commerce in the next three years, when larger parts of the population will have adopted the mobile device for far more than just voice telephony.

MOBILE DYNAMIC INFORMATION MANAGEMENT

The area of what we call dynamic information management is actually related to the mobile device as a secure storage tool for important information, that must be updated on a continuous basis.

Mobile Membership

Instead of using as a membership card a magnetic stripe or smartcard, club memberships could be stored on the mobile device, e.g. on the SIM card. Using Bluetooth in the phone and at the POS, you could be automatically checked in at your sports club, without having to carry the card with you.

Mobile Loyalty Programs

Loyalty or affinity programs, such as airline frequent flyer programs, require a card as well, which could just as easily be substituted by the smartphone or communicator. The device can also store the user's latest point levels for instant reference.

Danet in Germany has developed a WAP solution, which can be used to check your Lufthansa *Miles & More* frequent flyer account from your mobile.

Mobile Medical Records

The mobile terminal would be ideally suited to store a patient's entire medical records or to identify the patient enabling the records to be accessed via the web, so that they would be available whenever needed at a physician's office. This would not only add convenience, but it could significantly reduce costs to health insurance providers and patients alike.

Mobile Passport

Storing the passport information electronically on a secure device might in future replace the existing paper copy. Digital signatures or biometric fingerprints could replace today's hand-written signature. However, this is not likely to happen within the forecasting period of this report.

MOBILE INFORMATION PROVISIONING

As the web has shown, the range of information that can be provided is unlimited. It can be of very general, personalised or localised nature. Obviously, while the value of the information increases for the user, the more it is personalised and localised.

Until the arrival of WAP, mobile information provisioning has been based only on SMS. While WAP slowly penetrates the market (to reach a penetration of 85% of all mobile users by 2003, as predicted by Durlacher), SMS is already available in almost all GSM handsets in Europe.

Information can be pushed or pulled to the mobile device. In Finland the user types in a keyword, sends it to the SMSC (Short Message Service Centre) with the adjacent content server and receives an SMS back (pull). In Germany, however, mobile subscribers have to go to a web site and subscribe to certain information services that are consequently pushed to their handset.

The following information categories are already offered today, each by at least one European mobile operator. SMS based information services are actually generating very interesting revenues with high profit margins today, since the information acquisition is mostly quite simple and virtually no additional traffic is loaded to the mobile network.

For general news, content providers are supplying the input, such as CNN (who have an agreement with Nokia), Reuters (who have agreements with Ericsson and Nokia) or Handelsblatt Interactive (who have an agreement with Mannesmann in Germany).

A unique information set is provided by Omnitel in Italy, who have explanations to more than 100 tourist attractions throughout the country available in various languages.

General News

- What's happening today
- Text TV
- Headlines of the day
- Temperature conversion (°F to °C)
- DHL tracking information
- Shoe size conversion (UK to US to European)
- Speed, weight, power, volume conversion
- Events, festivals
- Attractions/sights opening hours
- Directory services



Sports News

- Football results
 - Football league
 - Football club
 - Football game program
 - Formula 1, Hockey, Basketball, Volleyball, Tennis, Rugby, Cricket,...
 - Golf dictionary
 - NHL, NBA results
 - Horse races results
 - World/European/Country Records
 - Ski slope information
-

Financial News

- Stock prices
 - Stock limit
 - Interest rates
 - Index prices
 - News of the day
 - Exchange rates
 - Currency converter
-

Entertainment News

- Horoscopes
 - Birthdays
 - Today's history
 - Jokes
 - Gossips
 - What's on in town
 - Nightclub listing
 - Band tour dates
 - Today's slogan
 - Museum opening hours
 - Recipe of the day
 - Music top 10
 - Wine information
 - Lotto, Bingo, Toto results
-

Program information

- Cinema/theatre
 - TV
 - Radio
 - Radio frequency information
 - Education
-

Travel information

- Train, bus, flight schedule
 - Bus arrival and waiting time
 - Parking space
 - Hotel
 - Lost credit card
 - Taxi
 - Tourist information
-

Each of these services generates at least one SMS on the network for the operator and the content provider or aggregator, who might make 25% of the revenues with this service. In Germany, Dr. Materna has supplied and managed the SMS services for the Mannesmann D2 network as well for E-Plus and Viag Interkom, and has even employed a 7 people editorial team, in order to create the content. Similarly, WAPIT creates Radiolinja's content in Finland, while Brainstorm is supplying information services to Vodafone in the UK.

MOBILE ENTERTAINMENT

Mobile Gaming

Currently there is virtually no wireless gaming existent. Because of the limited capacity of GSM, there are no multi-player games for use over the mobile network on the market. Within GSM phones, only very simplistic single-player games are available, such as *Snake* (on *Nokia 6110*), *Mobiletrivia*, *Navystrike* and *Stockmarket* (all on *Nokia 7110*).

Nokia has also developed a mobile entertainment solution that allows users of a 7110 terminal to play interactive games that are located on a server, such as traditional board and adventure games. A pilot service will be running on Singapore's M1 network in Q1/2000.

Mobile games could in future also be developed for PDAs, such as Handspring's *Visor*, which is equipped with a slot for an external Flash RAM (Random Access Memory). *Nintendo's Game Boy Advance*, *Sony's Pocketstation* or Sega's portable device which connects with the *Dreamcast* controller are also likely to become linked to wireless networks within the next 2 years. Actually, Nintendo has announced that they plan to use the *Game Boy* to download games over communications networks from the first half of 2000. Moreover, users will be able to exchange game data with other users and send e-mails from the device.

We believe that the advance in mobile gaming might be driven through the success of NTT DoCoMo's *iMode* portal on the packet data network and by the fact that Japan will have their world's first UMTS network up and running in late 2001.

Mobile Music

The availability of portable MP3 players will soon lead to music devices integrated with a mobile phone; Samsung has already developed an MP3-phone. Music titles will be stored locally at the mobile device. Korean consumer electronics company HanGo just announced a portable MP3 player that can hold 4.86 GB or up to 81 hours of music. Streaming audio files from radio stations, record companies and other web sites will become possible. Orange of the UK, soon likely to be a part of Mannesmann, have announced that they will introduce radio phones to the market in early 2000.

It could be possible that the user has a set of music licenses stored in his device, which permits them to download more titles. With the arrival of GPRS and new billing mechanisms, it will be possible to pay for titles rather than for a minute of downloading time.

We expect to see further mergers between mobile phone vendors and customer electronic companies, who might be able to further advance the combined device.

Mobile Video

Packet Video Corporation of the US is currently the only real-time streaming provider that delivers via wireless networks. Up to 5 frames per second can be delivered over the existing CDMA network. A new standard, MPEG-4, is emerging for video decoding.

We believe that store and replay technology from Replay Networks and TiVo is becoming integrated into GSM wireless devices, so that videos could be downloaded overnight or at a pre-set time and played from a phone-video player whenever wanted.



We do not expect wireless video reception to be shipped in quantities before the year 2003, although first showcase products have already been out for some time. We believe that there is a big demand for watching video content on transport, but the content must be short and of low bandwidth type, such as news pieces, sport highlights, weather, entertainment, horoscopes and the like.

Mobile Betting

Mobile betting will become a very interesting application for m-commerce, because it is time-critical, as with horse races, or it involves a lot of money, such as Lotto. In Germany, the first online Lotto company, fluxx.com, has announced that they are intending to offer their service via mobile terminals.

More interesting perhaps are the opportunities which will emerge for spread betting, such that for instance odds can be given on how many corners David Beckham might take in a particular football match or indeed how many he might take in the last 15 minutes of the match, or, where the match has already begun, in the next five minutes. The type of bets offered over the network would correspond to the profile submitted by the mobile betting service provider.

We are convinced that mobile betting will become a very interesting proposition and a variety of applications will be seen over the next two to three years.

MOBILE TELEMATICS

Driving directions provisioning is a very useful m-commerce application, since only relatively few luxury cars are equipped with a GPS-based in-car navigation system. In-car navigation has been realised so far mostly with GPS technology and CD-ROMs, which are inserted into the system inside the car. Motorola has developed a GSM mobile receiver system including GSM receive-only module from UbiNetics that receives updated traffic information from Trafficmaster via Cell Broadcast.

France's Webraska is providing real-time mapping, street-by-street guidance services and proximity services, that locate the nearest gas station from any address entered on the telephone keypad, for WAP mobiles. German CAS provides a WAP based route-planning service, which gives directions to the selected destination. Benefon of Finland has also launched a mobile map service, called *Arbonaut*, in co-operation with Geodata and a combined GSM/GPS phone, called *Esc!*

Debis Systemhaus in Germany, a subsidiary of DaimlerChrysler, has developed the *PTA* digital assistant for business travellers as a prototype. The *PTA* collects all traffic information, makes reservations of hotel rooms and concerts, selects the cheapest rental car and guides the user through the traffic. It is based on intelligent agent technology and is linked via GSM to a mobile phone or communicator.

Nokia has set up a business unit focussing solely on telematics, called Smart Traffic Products. They believe that every vehicle will be equipped with at least one IP address in the year 2010. The following applications are included within telematics: self-diagnostic service check for trucks and cars before break-downs occur, break-down-service when the vehicle has an immediate fault, emergency call when the car breaks down in a deserted area and, of course, positioning information about the exact location of the car. Similar services are currently offered via a satellite network for high end Chrysler customers in the US.

Durlacher is convinced that telematics will be an integral part of the mobile industry, once the above mentioned new services and devices hit the mass market during the next 12-18 months.

MOBILE CUSTOMER CARE

Current mobile service provider overhead costs for customer care are on average more than Euro 10 per subscriber per month (according to Phone.com). Therefore, mobile electronic customer care (m-care) becomes an economically interesting alternative to reduce costs by providing automated, unassisted operation directly from the handset. Mobile customer care has to be part of an integrated solution, which also includes access via the web, an intelligent voice response system and a call centre. There could be some extra revenues created by using m-care, but primarily it provides the possibility to reduce operational costs. In addition, mobile customer care could increase customer satisfaction because it puts customers in a better informed role and allows them to instantly change settings.

Interesting new technology in this space is *Universal Registration*, as developed by Davinci Technologies, i.e. single registration for interactive services, which works on both fixed and wireless web access interchangeably. Using this service, a user profile of all the key data and preferences will be developed once only and whenever needed sent to the particular web service provider.

BUSINESS M-COMMERCE APPLICATIONS

A variety of business processes could be streamlined by integrating mobility. Adding mobile devices as a choice of interface will create more easy online information access and data entry, extend the availability of key personnel for decision making and make processes more dynamic and real-time.

Below we indicate a selection of some areas of e-business, where we believe wireless will have a significant impact.

MOBILE SUPPLY CHAIN INTEGRATION

Integration of business processes along the supply chain is a key issue in wireline business-to-business e-commerce. We believe that as these become increasingly time sensitive and participants become increasingly mobile, smartphones and communicators must be integrated into the information exchange as one possible distribution path. The integration of mobile could take place on the buy side as well as on the sell side of Enterprise Resource Planning (ERP).

Unified messaging, for example, could be at the centre of those communications, making the user's choice of information access device and technology less of an issue. Moreover, it will be possible to make mobile reservations of goods, order a particular product from the manufacturing department or provide security access to obtain confidential financial data from a management information system.

By integrating the mobile terminal into the supply chain, it will be possible for e.g. a pharmaceuticals sales representative to check from the motorway or the customer premises whether a particular item is available in the warehouse. Already today, a SAP application has been developed for deployment on 3Com's *Palm* device.

3Com and Aether Technologies have joined forces to create OpenSky and to offer a service that gives smartphones and communicators mobile access to database applications. OpenSky will provide remote wireless access via personal digital assistants to establish secure connections to applications, such as *Lotus Notes*, *Microsoft Exchange*, ERP and CRM.

TELEMETRY/REMOTE CONTROL

There are very many applications, in which telemetry is being used today, but with falling mobile rates, new ways of using GSM technology seem to develop.

Maintenance and service needs of costly static machines and industrial equipment, such as a copy machine or a large drilling machine, can be metered with a sensor from the



distance via a regular phone line. Instead of using fixed PSTN (Public Switched Telephone Network) connection, the performance can be checked using GSM modules as well. This is especially relevant for machines in remote locations, where it would be very expensive and time-consuming to deploy a wireline telephone infrastructure, or for locations, where there are not sufficient dedicated phone-lines available for all the machines.

Preventive maintenance is applied, so that if there is any kind of problem with the machine, a warning will be sent via SMS or via modem sending a data call to a central supervisory system. In the latter case, the communication is purely machine to machine, while in the former, maintenance personnel will be able to access information about a particular component's performance and assess need for maintenance. If sensors are connected to an intelligent device such as a PLC (PROGRAMMABLE LOGIC CONTROLLER), the telemetry functionality can be extended to remote control, so that the service engineer can actively intervene at the remote site via a mobile connection. In Finland, these applications have been used, for example, in the water industry to remotely monitor and control pumping stations via NMT (NORDIC MOBILE TELEPHONE) since 1992.

Telemetry also offers strong applications for cars, for example as a remote vehicle diagnostics tool. Field trials have been conducted by DaimlerChrysler and Volvo to install GSM chipsets in cars to monitor performance and to provide an early warning system, which sends a message to the manufacturer indicating the problem occurring, e.g. high temperature in the engine, brake problems or "out of oil" alarm. The manufacturer's system will be able to analyse the various data and provide a fix via a software tool to be sent to the car or by asking the vehicle owner to go to a service station. Thus, developing faults can be found early and the continuous operation of the car can be ensured. It is likely that in future all cars will be equipped with mobile communication links, starting from the top of the line models first, but moving down the line fast. GSM chipsets have become cheaper and continue to fall in price. Compared to the incremental value created by the wireless link, the additional cost of installing a communication link is low. Communications costs can be negligible as calls are purely event-based. It is far more difficult to establish the processes around that application on the manufacturer's side.

NTT DoCoMo, for example, estimates the following connection figures for its mobile network by 2010:

NTT DoCoMo's Customers 2010	
Connected via Mobile	Number (millions)
Humans	120
Cars	100
Bicycles	60
Portable PCs	50
Motorcycles, boats, vending machines, pets, etc.	30
Total	360

Table 3 Source: The Economist

JOB DISPATCH

Mobile phones and communicators are increasingly becoming an integral part of groupware and workflow applications. For example, non-voice mobile services can be used to assign new jobs to a mobile employee. A service technician could be assigned a new task together with detailed information about the customer's problem, while she is on the road.

The target application areas for mobile field, delivery and dispatch services are:

- Transportation (delivery of food, oil, newspapers, cargo, courier services, towing trucks, taxis)
- Utilities (gas, electricity, phone, water)
- Field Service (computer, office equipment, handymen)
- Health Care (visiting nurses and doctors, social services)
- Security (patrol, alarm install)

A dispatching solution allows improved response with reduced resources, real-time work order tracking, increased dispatcher efficiency and reduction in administrative work. An interesting solution is delivered by eDispatch.com. With a web-based dispatching solution using smartphones, it is possible to save about 30% of communication costs, and efficiency of the workforce can increase by about 25%.

FLEET MANAGEMENT

Fleet management, a subset of intelligent transport services, is predicted to be one of the biggest growth markets for the next 15 years. Ericsson provides solutions, for example, together with Scania, who will integrate new features in its Infotronics subsidiary.

Start-up Aspiro of Sweden has developed a WAP based fleet management solution, which just needs a smartphone to be placed with the car driver. This is targeted at the professional driver, but is much cheaper than existing systems.

MOBILE CRM

Web-based CRM is already forecast to become the leading application software with a CAGR of over 50%. Thus, in addition to the well-established CRM vendors Siebel and Vantive, companies like Microsoft, SAP, Oracle and Baan are entering the market as well. We believe that business applications like mobile CRM will be able to gain quickly support (for example from companies in the IT and telecoms environment) and thus market share.

MOBILE SALES FORCE AUTOMATION

The current sales force automation tools, e.g. from Update, are already integrating a software architecture that is aimed for mobile commerce applications. The sales force on the road will be equipped with AP enabled mobile phones in order to have easy access to customer data at the central office. Key data, which can be retrieved, would include contact management information, order entry, product and spare parts availability and deal tracking. If the WAP device is a communicator type, sales forecasting and opportunity tracking could be done as well.

The travelling salesperson is able to check the latest status of his customer, just before she is going into her office, and she will be able to enter a successful business win immediately. One could argue that the demand for this kind of mobile tool, to get access to the office and valuable information fast, is latent with all travelling salespersons. We believe that we will see increasing applications in this space.



WIRELESS APPLICATION SERVICE PROVIDER (WASP)

We are seeing the first signs that the Application Service Provisioning (ASP) model for ISPs in wireline is moving to a Wireless Application Service Provider (WASP) model in mobile.

We see two basic WASP models arising in the context of this report. The first model is based on mobile operators providing applications services to corporate customers who wish to offer mobile commerce to end-users. The second model looks at providing wireless application services to the mobile operators themselves.

The mobile operators are in a prime position to host mobile applications for corporate customers, because many companies, especially SMEs, do not have the resources or the know-how to build and run them. Thus, the mobile operator turned WASP might not only provide a WAP gateway and the application server, but he might also develop the application and provide system integration services. Many mobile operators already manage the entire m-commerce platform for their (trial) customers in mobile banking applications.

The wireless application service Provider will offer not only the mobile commerce platform but also the implementation tools for both internet and intranet applications, or a services platform. Mobile operators today generally do not have sufficient expertise with system integration or with development of specific applications for the mobile environment. Therefore, they will need to co-operate with current SI (System Integrator) players in the market who bring competence for particular applications, such as ERP (mobile SAP), CRM, a mobile broking solution or a mobile commerce shop.

On the other hand, HP is positioning itself in the WASP space with a service called *Mobile E-Services on Tap* for mobile operators. These are advanced wireless capabilities based on infrastructure equipment owned and operated by HP and delivered to its customers, i.e. service providers and network operators, who pay for them on a subscription or pay-per-use basis. HP is offering the complete WASP solution.

With the *Mobile E-Services on Tap* model HP will host and operate the infrastructure for day-to-day business operators enabling the service provider to focus on its core competencies. This model includes all the technologies, management processes and global capabilities required for service providers to run and rapidly scale the business.

Mobile E-Services are value-added, internet-based services that undertake complex tasks including financial transactions and provide access to personalised information via the mobile network. In order to get their *Mobile E-Business* off the ground, HP has established a *Mobile E-Services Bazaar*, that will provide a trading community and a developers program for wireless operators, service providers, enterprise application providers and technology partners. HP has signed up 30 partners to date and will provide each with an additional marketing and sales channel. Whether this offering gets beyond the press release/prototype stage remains to be seen.

Phone.com is providing a WASP service with its *MyPhone* service that lets Phone.com operate a mobile portal for carriers under the carrier's own brand. It is considered to be more vertical than mainstream traditional portals with a special focus on the wireless device.

We believe that both WASP models have potential and will find a place in the value chain, since the entire mobile commerce market is still at the very beginning and infrastructure in terms of GPRS networks and (GPRS) WAP terminals is only now being put in place.

MARKET SIZING AND FORECASTS

The European market for m-commerce is driven by the increase in the number of mobile subscribers, by the availability of new equipment, by the amount and quality of applications and by push of new terminals via their price. Both, the mobile as well as the e-commerce market, have been traditionally always underestimated when forecast.

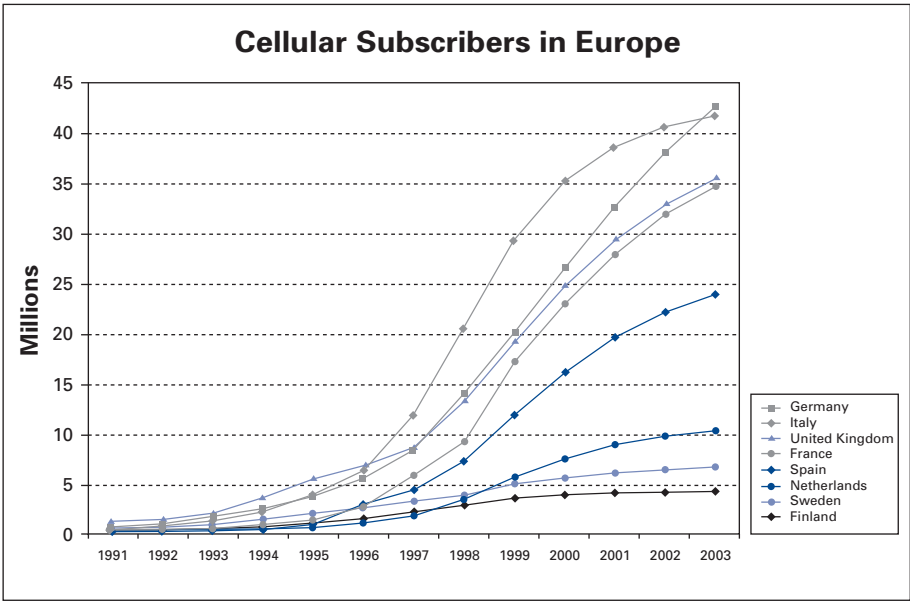


Figure 15 Source: Dataquest, Mobile Communications International

The number of mobile subscribers in Western Europe will increase from almost 90 million at the end of 1998 to over 237 million by the end of 2003 according to Dataquest forecasts. This represents an average penetration of about 64% across the continent, with a minimum of 50% in any country. We believe that all equipment will be based on the GSM standard (or the derived protocols WAP, GPRS, EDGE) or compatible with it as UMTS.

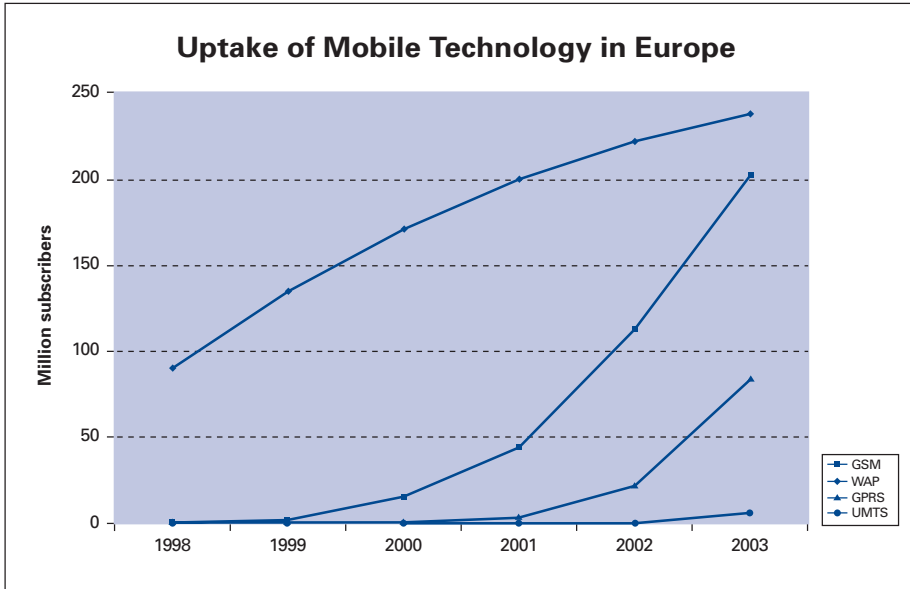


Figure 16 Source: Durlacher, Dataquest Mobile Communications International

At the beginning of October 1999, there were more than 300 million wireless users and more than 200 million internet users world wide. Globally an estimate of 1 billion subscribers for both the internet and mobile communications seems to be realistic by 2003. There will be large overlap between both customer groups.



By 2003, we believe that there will be over 200 million subscribers in Europe accessing information from the internet with a mobile device. This represents more than 85% of the mobile phone owners. Based on statements from several vendors and operators, we have assumed that after 2001 no more phones will be shipped by the vendors that are not internet-enabled via a microbrowser.

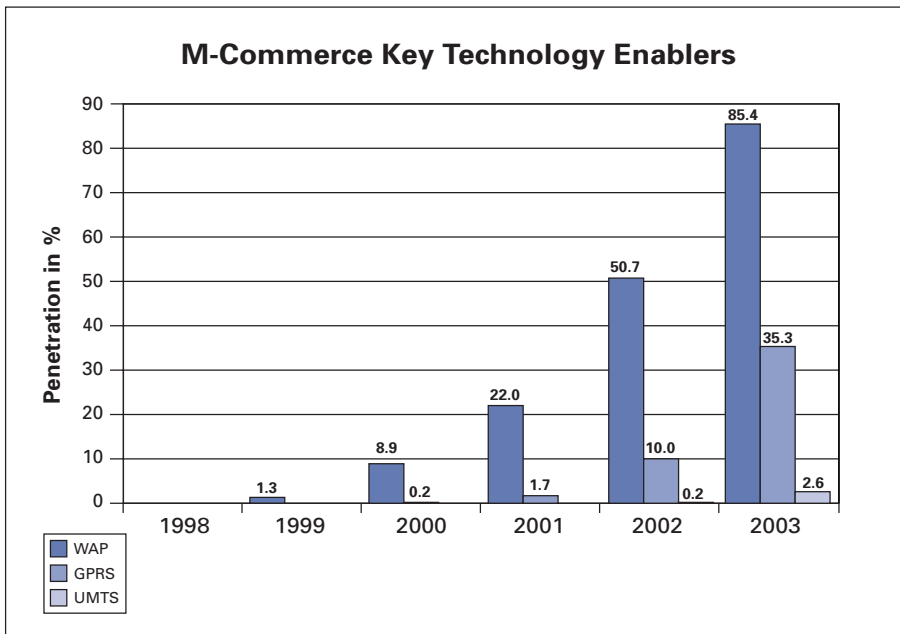


Figure 17 Source: Durlacher

While GPRS will have its big year in 2003 (being used by 35% of the mobile users) and also fostered by the arrival of EDGE, UMTS will start slowly and will have reached no more than 2-3% penetration across Europe by this time.

Content providers can generate revenues from mobile commerce using any or a combination of the following business models:

- Advertising
- Sponsorship
- Revenue sharing with mobile operator (part of airtime or volume generated by the service)
- Subscription-based services
- Transaction fees as for other e-commerce applications (stock trading)

The current situation is that although users are accustomed to paying for mobile services (and an increasing number also for value-added services such as SMS information), web content in general is expected to be free by large parts of the population. Therefore, m-commerce users will also expect a large number of services to be free of charge.

Delivery of free high-value content to the user could be achieved with a business model that is built around advertising and/or sponsoring. We would tend to agree with those in the industry who believe that advertising-only models are not the way forward. New, creative models have to be developed in order to utilise the mobile device in an optimal manner as a one-to-one marketing tool.

We believe that the following aggregated m-commerce revenues per subscriber per month can be achieved on a pan-European basis.

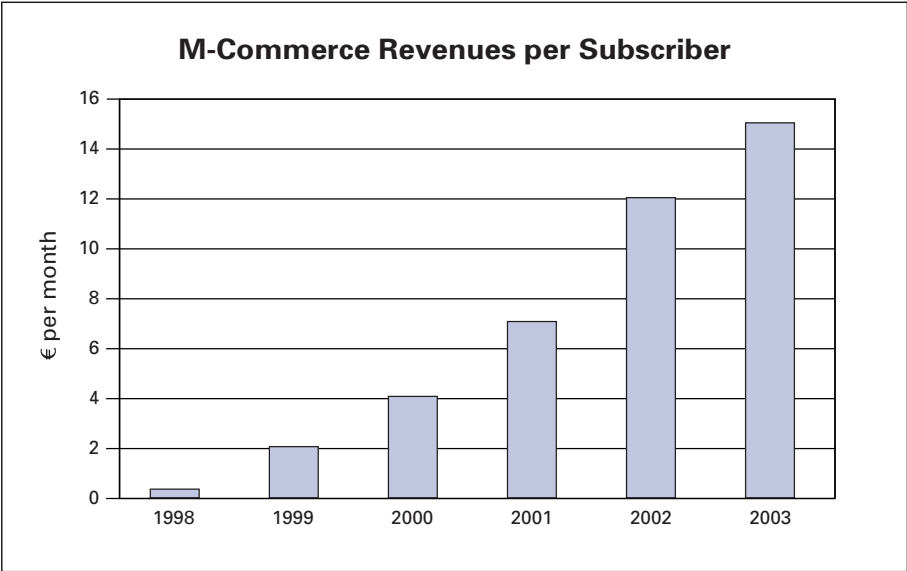


Figure 18 Source: Durlacher

According to Durlacher’s projections the European market for m-commerce will increase from about Euro 323 million in 1998 to Euro 23.6 billion by 2003. The m-commerce market will therefore have a CAGR of 236% until 2003.

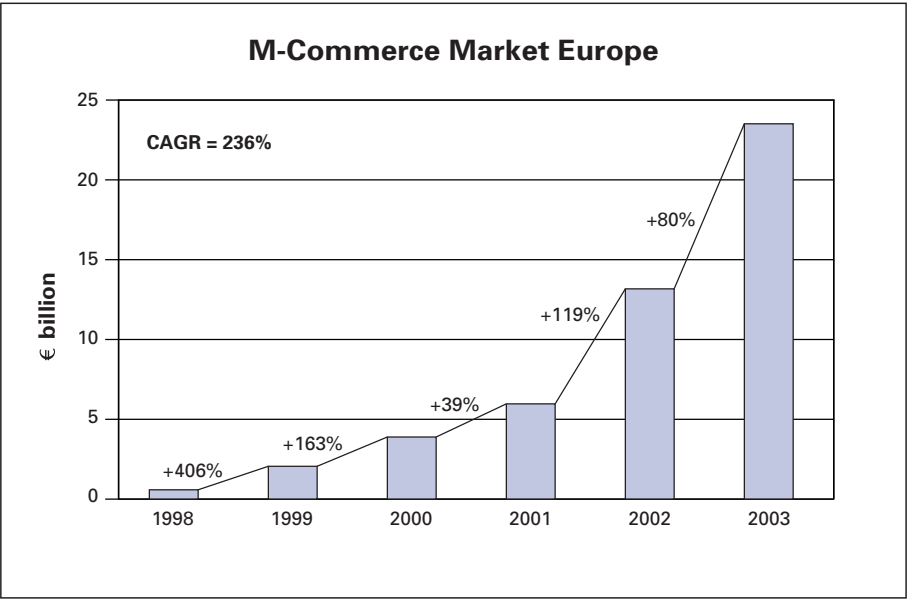


Figure 19 Source: Durlacher

The country generating the most revenues from m-commerce will be Italy (Euro 4.8 billion), followed by Germany (Euro 4.1 billion) and the UK (Euro 3.4 billion).

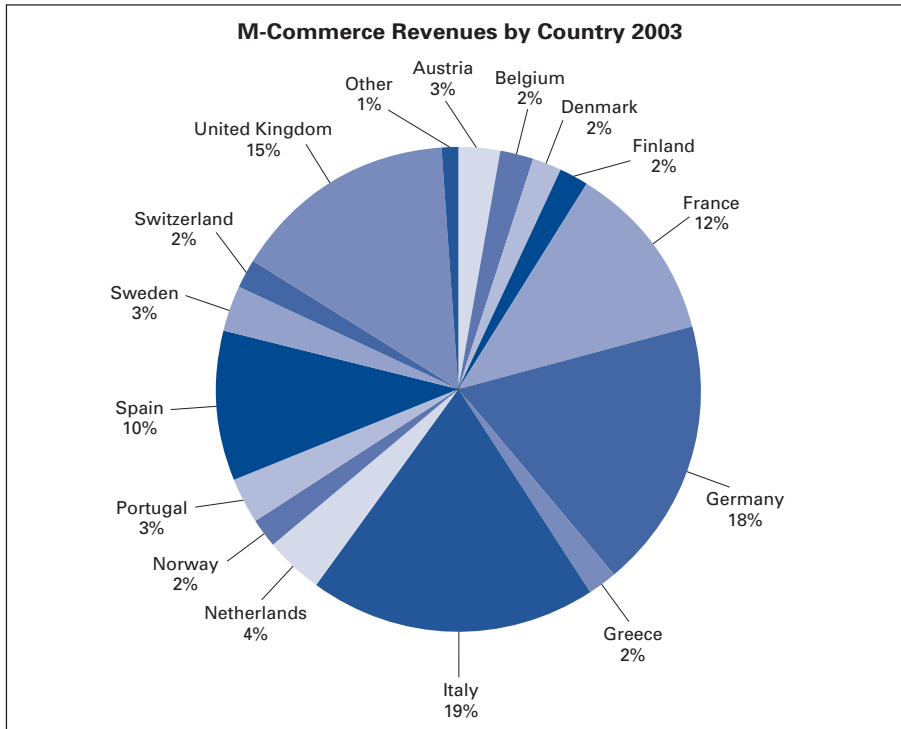


Figure 20 Source: Durlacher

In terms of the leading applications during the forecast period, Durlacher expects advertising to become the key provider of m-commerce revenues (Euro 5.4 billion), once the power of the mobile as marketing tool has been fully discovered. We believe that financial services, such as mobile broking, mobile payment and mobile banking, will be the second largest revenue source with Euro 4.9 billion. Actual mobile shopping, including for example retailing, ticketing, reservations and auctions, will be worth Euro 3.5 billion. It is important to note that those top 3 applications will together make up only 60% of the total European m-commerce revenues in the year 2003. The remaining share is generated by a rather larger selection of applications, such as business applications, telematics, customer care, entertainment, information provisioning and security.

The development of the importance of the various m-commerce applications is indicated below. While in the year 1998 information provisioning was by far the largest contributor to mobile commerce revenues (91%), its relevance is decreasing continually over the years and will be only 5% in 2003. This shows that the market is in a very early stage and the overall market growth will be driven by the arrival of new services.

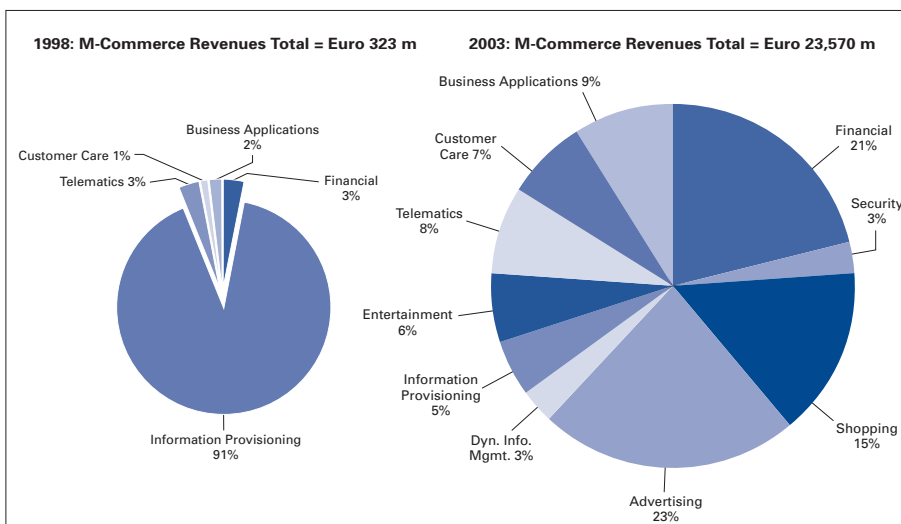


Figure 21 Source: Durlacher

INDUSTRY OUTLOOK

MOBILE PORTALS

The mobile portal today is emerging, in many ways, as a stripped down version of traditional web portals, representing a subset of available content targeted toward the understood preferences of the user base. Relevance becomes critical. Moving forward, we expect many specialised portals to emerge, optimised for and targeted at the mobile world. These will include new mobile-specific services not found on traditional portals.

The key requirements of a mobile portal are to provide the following functionalities:

Personal information management (PIM) includes many of the functions of current PDAs, such as the maintenance of a personal address book, personalised calendar functionality, the management, writing and reading of notes and memos. Synchronisation with desktop applications, e.g. *MS Outlook* or *Lotus Notes*, might be required for an initial changeover period. We believe that PIM applications will be increasingly web based (as offered today by Yahoo! and many other major portals) rather than desktop based and wirelessly accessible in an always connected mode, once GPRS is widely deployed in the network and in terminals. Microsoft has announced the availability of its *Office* software over the net as early as Q1 2000 as a response to Sun's acquisition of German *StarOffice*. Sun is planning to make this *MS Office* compatible software package available on the web for free by Spring 2000 in order to boost its thin client network computer concept. Synchronisation with smart phones and communicators will be necessary to ensure anytime/anywhere access to this information.

Personalised content is key using mobile devices, because of the limitation of the user interface. Relevant information must always be only a "click" away, since web access with any existing wireless device is not comparable to a PC screen either by size, resolution nor "surfability". Key personal information includes MyNews, MySports, MyPortfolio, MyWeather, MyHoroscope, MyInterests.

Alert notifications are also an important part of personal content, such as for auctions, betting, classifieds, stock price changes etc. Obviously, the mobile portal ideally communicates with the user in her mother tongue.

Communication facilities within the mobile portal are key applications. Therefore, communicators are being designed that can perform many of the following functions: sending and receiving e-mail, voice mail forwarding, conference calling, faxing, document sharing, instant messaging and unified messaging.

Location-specific information leverages the key advantage a mobile portal has over a traditional web portal by supplying information relevant to the current geographic position of the user. Information requirements may include, for example, restaurant bookings, hotel reservations, nearest petrol station, yellow pages, movie listings. Intelligent inference technology backed into a database works with profile data based on the user's past behaviour, situation, profile and location.

Initially, the market for the mobile portal has to be created, a subscriber base has to be built and airtime must be generated. A good way for doing that is through the use of messaging or e-mail, because customers generally understand these applications and are using them already.

Mobile Operators

Most mobile network operators across Europe are now building portals, mainly with third party data from existing portals or content feeds. The operators are not experienced on the content side, but they have been capturing subscriber data. Mobile operators have the following main advantages over other portal players:

- Existing billing relationship
- Substantial, verified subscriber data
- Location of subscriber



However, location services are not yet widely available as positioning technologies are just starting to get installed by the operators (Sweden's Tele2 is launching the first location services based on Cellpoint's handset-based technology in November 1999).

The European operators that have been among the first to announce or launch a portal service are Sonera (Finland), Omnitel (Italy), TIM (Italy), Telia (Sweden), T-Mobil (Germany), Mannesmann (Germany), Telenor Mobil (Norway), Radio Mobil (Czech Republic), Orange (UK), BT Cellnet (UK) and Vodafone (UK). BT Cellnet has been very early with its *Genie* portal, gaining more than 200,000 subscribers. Most portals run by the network operator have limited the access to their own subscribers. BT Cellnet decided to give up this approach in order to gain critical mass and opened their *Genie* in 1999 to customers of other networks as well.

Japan's NTT DoCoMo's *iMode* is the world's first mobile portal, which has a significant number of subscribers. In October 1999, nine months after the launch, there were more than 2 million people (or 8% of its subscriber base) using the service. It is not based on circuit-switched WAP/GSM technology, but rather uses a proprietary Japanese packet mobile data network, which requires special *iMode* handsets. More than 200 content providers have developed sites for the handsets, mainly financial services (banks, brokers, credit card issuers) and insurance companies, but also ticket and travel agencies as well as newspapers, CD and book sellers and games and entertainment services. In addition, more than 2000 regular web sites are automatically translated for access with *iMode* terminals, but their functionality is limited. The network protocol used is comparable to GPRS on GSM networks. Thus, similar services will be available in Europe only from 2001 onwards.

NTT DoCoMo, Telia and Sonera are all interested in transferring their portals into other markets. Sonera is aiming at internationalising its *Zed* portal in early 2000 primarily into those countries where it already has ventures, such as the US, the UK, Benelux and the rest of Scandinavia. MCI Worldcom subsidiary UUnet is also going to add WAP gateways to its network infrastructure and is offering a portal with e-mail and news services.

Technology Vendors

Mobile network providers Lucent (with its *Zingo* portal) and Ericsson have both launched a mobile portal during 1999. However, *Ericsson's Mobile Internet portal* service is more a demo portal, an accumulation of different applications provided by some application developers, than a managed product. Motorola has launched its *Mobile Internet Exchange*, where it provides content, such as *Worldspan*, one of the largest online travel reservation systems.

Through *Mobile E-Services Bazaar*, which consists of applications and services from more than 30 partners, HP hopes to push its WASP services to the operators. Sharp's *Space Town* is a portal that will provide relevant content for the entire portfolio of communication products such as PDAs. Spyglass has also announced a demo portal with news for Q1/2000 that should support the marketing of its *Prism* technology, a content delivery platform.

The mobile portal provided by a technology vendor is basically used to gather content that can help in selling WAP gateways, WAP handsets and so forth. We believe that these will represent a temporary effort from the vendor community to help develop the market, which will be terminated as soon as sufficient momentum has been created.

Traditional Portals

Established large portal players have recognised the potential impact that the mobile internet and therefore mobile commerce can bring them. In order to position themselves favourably early on, players such as Yahoo! and MSN have created mobile portals, which are targeted at US subscribers only at this point in time. Both their content and choice of terminal for information access are not relevant for European users. However, we expect that during Q1/2000 many of the major portals will also have established themselves in the largest European markets. Yahoo! is adopting a co-operation strategy with local partners as they

have for instance in Germany (with Mannesmann *D2*) and in Sweden (with EuroPolitan). Excite is co-operating in Japan with NTT DoCoMo in the successful *iMode* portal.

Our view is that regular, "traditional" portals are not providing information that is specific enough for the user of a mobile portal. They are not able to incorporate location-specific information nor do they have the data and knowledge of each customer that the mobile operator has. In many instances, the traditional portal player knows nothing more than an e-mail address, which is basically in the form of, DonaldDuck@hotmail.com or MickeyMouse@Yahoo.com. The true identity of the user might not be known. Moreover, the traditional portal does not usually have a billing relationship with the customer (with the exception of AOL, T-Online, CompuServe and others who also offer internet access).

New Players

New players and start-ups, who are interested in positioning themselves as a mobile portal, start out generally as a technology provider with a view that they might want to offer content to drive the business in the future. Quite commonly they have developed proprietary technology, which can facilitate the process of content providers starting AP enabled services. Examples of this type of company are Breathe and Digital Mobility, who are aiming to establish mobile portals in the UK. Breathe has announced specialised vertical portals for the finance, insurance and accountancy industries using Autonomy's knowledge management technology that can be accessed via a variety of mobile devices. In contrast, Digital Mobility has developed a web hub server, which is a piece of middleware between existing web servers and the WAP world, and they are in the process of designing a portal around it. In Sweden for example, Concurrent Data Dynamics has developed a portal around the company's own *Allt.com* search engine and its *Grail* web search software.

The general decision the new players have to make when they are building their portals is whether they want to market the portal themselves under their own brand or sell it as an operator branded product. Since mobile operators have learned through the SMS experience that in some cases it can be painful to outsource a core service (Mannesmann provided Dr. Materna with a very lucrative business by outsourcing the entire SMS platform to them), they are less prepared to give the mobile portal away to a third party. Eventually, the new provider might provide the service for a very short time period, until the operator has developed its own offering. Thus, the newer players must also market their own portals independently or with an ISP or another company.

We believe that new portal players can only be successful when they manage to transform themselves into true content players and focus in particular market segments and niches, which are not addressed properly by the existing big guys.



The Power of Portal Players		
Wireless Portal Player	Strengths	Weaknesses
Mobile Operator	Billing Relationship Location Information Strong National Brand	Little content expertise Little partnering experience
Equipment Vendor	Technology understanding Developers contact	Not core business Not core expertise
Traditional Portal	Strong portal expertise Leading content/apps. Strong partnering experience	No mobile experience No location information No billing usually
New Player	Flexible Niche focus	Technology focused No content expertise

Table 4 Source: Durlacher

Durlacher believes that the ideal combination for creating a mobile portal would be the mobile operator plus an existing portal player, because they have complementary strengths. Although first a partnering approach might be chosen, acquisition of equity stakes seems to be the likely next step.

KEY SUCCESS FACTORS FOR M-COMMERCE

The successful development of the m-commerce market will depend on operators taking advantage of the following capabilities within the mobile environment:

Customer Ownership

Subscriber data, such as billing address, mobile phone number, e-mail address, choice of mobile device and calling patterns, are becoming ever more valuable in the light of mobile commerce. In addition to passive collection of user behaviour and data, companies will be able to benefit from users actively providing and specifying their own choices and preferences to the portal provider.

The mobile terminal is the perfect vehicle for delivering one-to-one marketing. Mobile firms can link stated individual characteristics with a database, which can extract or infer preferences. Therefore, network operators (especially when they are also service providers) are in pole position to leverage the data warehouses they have built over the years.

The latest takeover wave in the mobile industry is re-characterising the role of the network provider. While Deutsche Telekom acquired Cable and Wireless's One-to-One interest in August 1999 for approximately Euro 4040 per subscriber, Mannesmann has offered Orange as much as Euro 9452 for each subscriber in October of the same year. Established portal players (such as AOL, Yahoo!, and the UK's Freeserve) understand that in the short term it is important to build market share and a large, well-defined subscriber database which can be later leveraged as a platform for m-commerce transactions.

We believe that ultimately the question is not "who owns the customer?", it is "who does the customer buy into?". In a multi-channel, multi-device, multi-source world, the customer can easily switch access device, internet service and portal. So who does the customer buy into? It will be the mobile portal provider that holds the user's personal data and preferences and uses them to add value to the user's experience. The mobile operators do have a unique position in the mobile portal world, but they must build new competencies quickly.

Personalisation

Personalization is about creating services that customise the end-user experience for the individual subscriber. It is based on one-to-one relationship management and therefore provides the ideal tool for one-to-one marketing. An intelligent personalization platform must be able to learn from both user preferences and past behaviour of the user. The application must be personalised enough to optimise the interaction path, enabling the user to reach the services they want with as few clicks as possible, and presenting information in a compact form optimised for the smartphone or communicator. Companies must also be proactive with respect to service behaviour, i.e. anticipating future requirements of the user and suggesting a likely choice. We believe that personalisation is the difference between a usable application and an unusable application.

Localisation

There are several competing technologies that enable mobile location or positioning services. Location-sensitive information becomes key in mobile commerce. Knowing the location of the user drives the service and application offering to a level that creates significant value to the user. User need local information about their normal local environment. Location specific information is even more valuable in new environments, when travelling.

Ubiquity

The ability to receive information and perform transactions from virtually any location is especially important to time-critical applications, such as stock and options trading as well as betting. Providing mobile users with a similar level of access and information to that available in the fixed line environment is key.

Timeliness

Mobile enables the transmission and use of time-sensitive information whose value is inherent in its immediate delivery. Information transmitted too late can incur significant opportunity costs. It is in such environments that mobile information services come into their own.

Convenience

We are strong believers in technology, but only with the purpose of making life easier for people and taking away the pain of unpleasant tasks and activities. One should always question how a solution could provide added convenience to the user. Technology in itself is exciting, but only its use to increase the quality of life makes it valuable.

Based on the core competencies of the companies that make up the m-commerce value chain, a number of observations can be made as to their evolving roles and implications for the future of this market.

VALUE CHAIN MODELLING

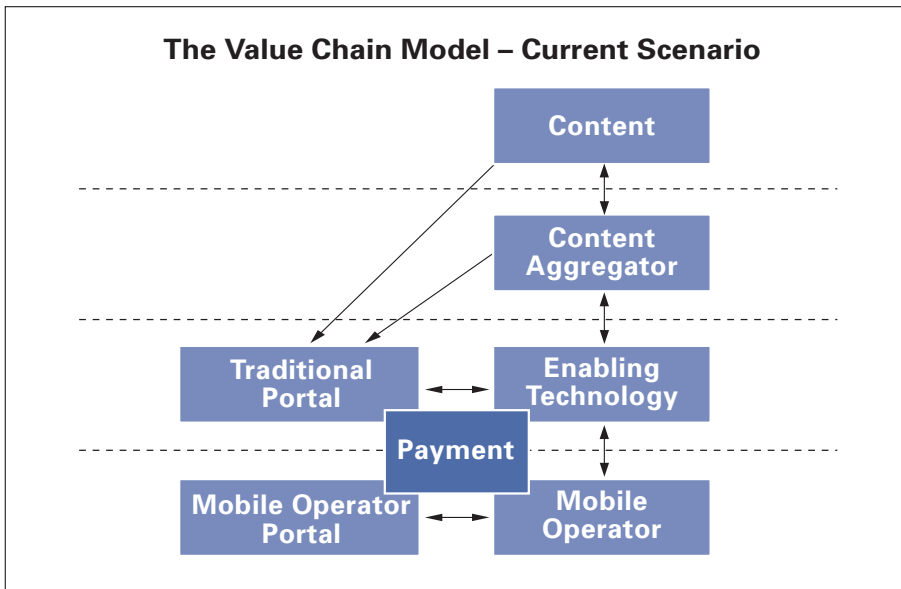


Figure 22 Source: Durlacher

Content Provider Strategies

The content providers in the mobile commerce value chain are mostly concerned with distribution. They want to ensure that their content reaches the public by as many means possible. Reuters, for example, is providing a subset of its information to both Nokia and Ericsson, as well as to mobile operators, who are all offering a mobile portal. Additionally, Reuters is launching a proprietary portal service, which will include the complete portfolio of news, not just a small section, because they believe that the m-commerce market is too important to rely on a single distribution channel. Use of a broad range of distribution channels allows content providers to hedge their bets on the evolution of platforms, ensuring key positioning for their content and building multiple revenue streams.

Content Aggregator Strategies

Content aggregators are trying to stay close to various portal players and ideally sell the same product more than once. The aggregators bring a wealth of useful knowledge to the table because they are used to partnering and negotiating with content owners and other companies in order to develop information applications. Content aggregators might become potential acquisition candidates, as their role is close to the portals while also being close to the original content.

Enabling Technology Provider Strategies

The enabling technology provider benefits from the shift in mobile communications towards m-commerce. They offer a variety of platforms and services that have been earlier run by mobile operators. The software companies and system integrators will increasingly take on projects to build complex applications. IT specialists will provide the middleware, similar to their role in the internet environment.

Mobile Operator Strategies

The mobile operators need to position themselves at the centre of m-commerce development, since they stand to lose significant revenue streams from the drop in ARPU because of a continuous price decline for their voice services. The mobile operator is fearful of becoming a pure infrastructure supplier, like a vanilla ISP. New mobile commerce enabling

applications, such as e-mail and instant messaging, are the first step up the value chain, but ultimately the mobile operator aims to occupy the mobile portal space with a participation in transaction revenue and the handling of the payment side of the transactions. Mobile operators have the strength of owning all their subscriber data, and have access to the location of the customer. However, mobile operators are not experienced in the content business or in partnering with other players, both activities that would be useful for the development of sustainable revenue streams. The operator will use their existing billing relationship with the customer to enhance their current service portfolio; they might use their current valuations to acquire both a banking license and a portal provider, who bring the missing skills to the table. With this amended business model, the mobile operator will also be able to host more applications as a WASP, which can be only done in conjunction with a systems integrator providing the project management experience.

Traditional Portal Strategy

The mobile portal strategy of the traditional portal players often lacks in-depth understanding of national mobile markets and of the specific local dynamics involved in building businesses in a territory. In addition, the differences between a fixed and a more mobile portal model are non-trivial and, as such, lessons learned in the past are not necessarily directly transferable. What they do possess, however, is an existing brand image and an understanding of how to enhance the online experience of the user. We expect that two different types of portal providers, i.e. the traditional portals and the mobile operators, will ultimately join forces and merge. Users do not want to access multiple levels of portals to help them manage their lives; they need only one gateway to the internet world.

Payment Agents

Payment agents, i.e. banks and credit card companies, are trying hard to occupy a space within m-commerce by piloting many different technology solutions. They are trying to squeeze themselves somewhere into the value-chain in order to defend their right to exist by introducing, for example, payment smartcards. However, in many cases, these physical smartcards are not necessary for any other reason than having the Visa logo and the bank’s name on them (thus including these two players in the m-commerce playground). There is the danger that in future mobile operators will include the payment and wallet functionality on the SIM card within the phone. However, mobile operators are not able to offer payment services if they do not own a bank license. Thus, it is likely that mobile operators will move up the value chain and take over the payment agent’s role.

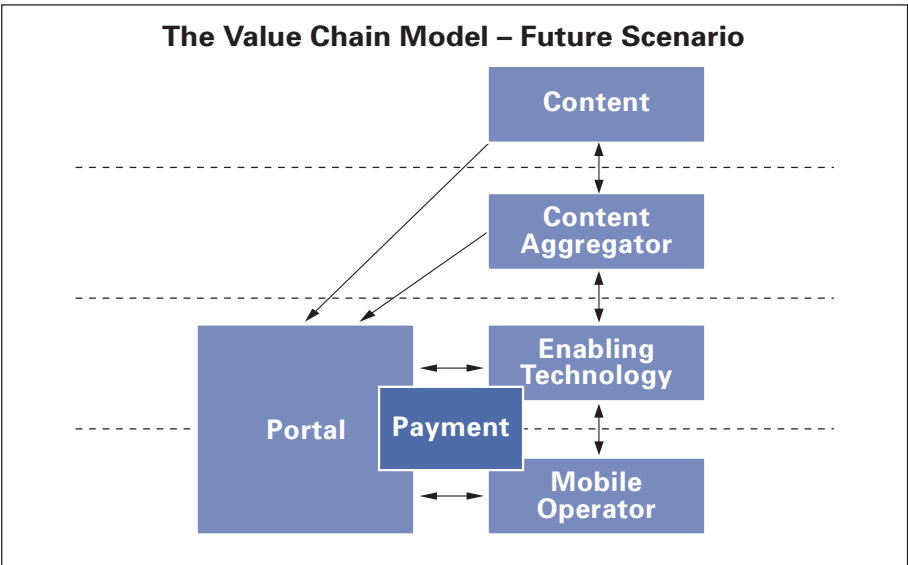


Figure 23 Source: Durlacher



INVESTMENT OPPORTUNITIES

Based on the discussion above, we believe that the development of the mobile commerce space will yield some significant investment opportunities over the next four years. However, the opportunities indicated below originate from our subjective view of the market and, although we have undertaken every effort to analyse the upcoming m-commerce market as thoroughly as possible, we clearly cannot guarantee the definite and timely emergence of all the factors necessary. The list is indicative rather than exhaustive.

In the following text we outline a roadmap of opportunities according to the time horizon during which we expect them to take off.

SHORT-TERM OPPORTUNITIES

The market for mobile commerce applications based on WAP (and other protocols) is still relatively undeveloped, because of the continuing existence of a large variety of devices and user interfaces, complex solutions for wireless connection, slow data speeds and untested and in some cases untrusted security architectures. While WAP gateways are now becoming widely available, m-commerce applications are still only available on a limited basis. Applications and services which are localised for the users position, preferences and timeliness requirements will be key in the immediate term.

In the next 12 months we believe that the following investment opportunities will emerge.

First Generation WAP-Only Developers

The first content and applications to be specifically developed for WAP devices have in our view a very significant opportunity to gather market share in the early developmental stages of the market.

Repurposing of E-Commerce Delivery Infrastructure for Mobile Access

Existing applications, which have proven their success in wireline e-commerce, will need to add a mobile distribution component very quickly if they want to ensure participation in portal development. Specialist system integrators will play a major role in the repurposing of applications for mobile use.

Acquisition of Content

The mobile portal provider needs to get closer to content providers and aggregators. We expect that the current relationships of mobile operator and content provider will become more important and cellular operators may well begin to buy equity stakes in those they deem best of breed content providers in accordance with their overall corporate plan.

Mobile E-mail Platforms

E-mail is the upcoming mobile mainstream application, beyond the existing popularity of mobile voice and SMS. E-mail applications will have to be implemented by all mobile operators, possibly through existing applications being extended to the mobile space by ISPs. Advanced platforms, which allow e-mail access anytime from any device, are required to deliver a superior user experience, no matter whether the e-mail is hosted by an ISP service or resides on a corporate e-mail server.

Personalisation

Developing applications for intelligent, automatic personalisation on mobile devices is a business activity for which there will be plenty of demand. Since e-commerce personalisation technology providers Broadvision and Vignette have just started developing technology solutions for this market, applications are almost non-existent, but our expectation is that the market will be populated very quickly indeed by new mobile specialists and by mutating incumbents.

Mobile Portals

Mobile portals come in a variety of flavours and there will be space for a number of them, next to the mobile operators and the existing general web portals, for particular user groups. Subscriber profile ownership is key in future as it will allow selectively targeted m-commerce and advertising.

Speech Recognition Based Applications

The mobile communications industry urgently needs further developments in speech recognition technology and applications based on it. Benchmarking against Orange's *Wildfire* product, this will enhance the user experience of the mobile terminal significantly and it will add convenience to accessing information as well as sending and receiving e-mail.

Positioning Technology

Current positioning technologies are just entering commercial availability, but further developments are required to improve the detail and accuracy with which the exact location can be determined.

Compression Technology

Compression technology is increasingly important as bandwidth demand increases with new applications and current technologies are limited to smaller capacity. Compression could provide significant input in levelling out bandwidth shortages.

GPRS Applications

In order to take off by early 2001, GPRS will need applications that utilise the competitive advantage of always on connections at fairly high transmission rates. Specific applications are likely to be built around gambling, stock market and other time critical areas.

Synchronisation

There are only a few players providing services for the synchronisation of smartphones, communicators and PCs, but an increase in demand can be expected in the short-term. Managing data systematically, so that it has to be entered only once, but remains identical across platforms, requires both sophisticated applications and technologies. Although the underlying applications are already available, there is a market need for applications developed specifically for this space.

Mobile Commerce System Integrators

Mobile system integrators – combining the skills of SI's with mobile experience – are almost non-existent today – this combination of skills is likely to command a premium moving forward. New mobile media consulting is a crucial skill set currently not available to larger vendors and consulting organisations, but one that is necessary to develop



company specific applications around existing processes and adapt available technology platforms to an organisation's individual needs. For example, because of the lack of mobile commerce consultants, Nokia is currently developing the mobile broking system for Deutsche Bank. Although this is outside Nokia's core competence, WAP integrators are yet to emerge and Nokia needs to get the market moving.

MEDIUM-TERM OPPORTUNITIES

In about 12 to 24 months m-commerce will provide the following opportunities for investments.

Acquisition of Content

The acquisition model for content is likely to be extended into the mobile space and content providers might be totally acquired in order to secure exclusivity.

Acquisition of a Portal

Mobile operators, who have not been successful in developing their own mobile portal may be forced to acquire a portal player to enable them to extend their service portfolio.

Mobile Advertising

Mobile advertising provides the perfect tool for very targeted one-to-one marketing based on the user profile and location. Appropriate business models have yet to be developed – these may include sponsorship or payment to users for reading advertisements. Applications to facilitate or manage the entire personalised advertising process are currently not available, but again Broadvision's or Vignette's platforms could be used as the basic technology foundation.

Banking Solutions

Acquisitions by mobile operators will most likely include online or mobile banks given their better fit with the mobile business model than a more traditional retail bank. The first step will be to sign those banks up and move them to the WAP environment, before potentially converting this relationship into an M&A type transaction.

Bluetooth Applications

Once Bluetooth chips are integrated into devices, applications for utilising the possibility to interact from machine to machine must be created. One key area is synchronisation between Bluetooth-enabled terminals, but communication, payment and security applications are also important.

Location-Dependent Information

Currently, several competing technologies have emerged to solve the positioning problem, but the real commercial application of any one technology is still to be proven. Nonetheless this type of information is a key part of the mobile value chain and as such it will be a space which will be populated as the market evolves.

M-Commerce Middleware

There is a place for a variety of middleware providers, who can handle some of the more critical issues, such as security (PKI), mobile payment technology, m-commerce platforms and mobile advertising platform technology.

Business Applications

Integrating the new breed of mobile terminal equipment into corporate business-to-business processes will create opportunities for companies that can provide a link from, say, Siebel's CRM or SAP R/3 software to WAP or GPRS devices and integrate them as a complete solution.

WASPs

Extending the application service provider model into the wireless space opens up a whole range of new opportunities for participants that provide a hosted WAP gateway or the entire wireless front-end to existing operations. There is currently a lack of know-how in many organisations with respect to wireless technology. WASPs providing a managed end-to-end solution can overcome this.

Entertainment Services

We estimate that early technologies and applications that make it possible to create customised content and then repackage these for distribution via the mobile network, will be in demand from 2002 onwards. Similarly, the market will require application platforms for music downloads into MP3-enabled mobile devices, as well as video streaming and mobile interactive multi-player games.

Infomediaries

New infomediaries for the wireless space will probably emerge who will broker relationships between network owners and content providers. Mobile operators might extend their influence in order to control these content aggregators.

LONG-TERM OPPORTUNITIES

From 24 months onwards, a number of investment opportunities can be expected in the following areas:

Payment solutions

Once PKI infrastructures have taken hold as an integral part of mobile commerce, mobile operators are likely to position themselves as banks through the acquisition of suitable players.

Mobile Dynamic Information Management

The use of the mobile handset as a device to store extensive personal data will be enabled by the availability of multi-functional SIM cards. This will enable information such as club memberships, frequent flyer points, travel tickets and passes etc. to be stored on the mobile device, alleviating "fat wallet syndrome", from which many persons suffer today.

Mobile Passport

Creating applications that will not only hold a credit card, but also a unique document, such as a passport, on a mobile device, will be enabled through the widespread introduction of security measures, e.g. digital signatures based on PKI.



GLOSSARY

3G	3rd Generation mobile technology according to IMT-2000 standard (e.g. UMTS in Europe)	E-OTD	Enhanced Observed Time Difference
API	Application Programming Interface	ERP	Enterprise Resource Planning
ARPU	Average Revenue Per User	ETSI	European Telecommunications Standards Institute
ASP	Application Service Provisioning	FCC	Federal Communications Commission (US regulator)
ATM	Automatic Teller Machine	GAA	GPRS Application Alliance
Biometric	Identification of a person by a physical or behavioural characteristic (such as the way they sign their name, their fingerprint or the marks on the iris of their eye).	GPRS	General Packet Radio Services
Bluetooth	Chip technology enabling seamless voice and data connections between a wide range of devices through short-range digital two-way radio.	GPS	Global Positioning System
CB	Cell Broadcast	GSM	Global System for Mobile communications
CB	Cartes Bancaires (French credit card issuer)	GSM 1800	GSM operation at 1.8 GHz; formerly DCS 1800
CDMA	Code Division Multiple Access. Allows reuse of scarce radio resource in adjacent areas. Can give interference	GSM 1900	GSM operating at 1.9 GHz; formerly PCS 1900
CDMA2000	North American flavour of IMT-2000	HSCSD	High Speed Circuit Switched Data.
CDP	Cellular Digital Packet Data	IDEN	Integrated Digital Enhanced Network
CAGR	Compound Annual Growth Rate	IM	Instant Messaging
COO	Cell of Origin	IMT-2000	International Mobile Telecommunications 2000. The IMT-2000 system will provide a seamless, global communications service through small, lightweight terminals
CRM	Customer Relationship Management	IN	Intelligent Network
DES	Data Encryption Standard (or Data Encryption algorithm); the most widely used method for "symmetric" encryption. The main source is ANSI X3.92.	IP	Internet Protocol
EDGE	Evolved Data for GSM Evolution. Allows networks to meet many of the requirements for UMTS	ISP	Internet Service Provider
EMPS	Electronic Mobile Payment System	ITU	International Telecommunications Union: the international body responsible for telecommunications co-ordination, the successor body to CCITT
EMV	Europay-Mastercard-Visa specifications for chip-based payment cards. EMV 1 corresponds with (and generally conforms with) ISO 7816 parts 1-5; the other parts of this specification cover the details of a standard credit/debit application and the requirements for terminals	IVR	Interactive Voice Response
		Java	A high-level object-oriented language, allowing applets (applications) to be written once, run anywhere (whatever the platform is). The aim is to help simplify application development.
		KM	Knowledge Management
		LAN	Local Area Network
		LFS	Location Fixing Scheme

MexE	Mobile Execution Environment	SIM	Subscriber Identification Module. Smart card holding the user's identity and telephone directory; SMS-Applications may reside on the SIM
MIM	Mobile Instant Messaging	SMS	Short Message Service. Facility for sending text messages on GSM handsets
Mondex	The electronic purse system developed by NatWestBank in the UK, it is now 51% owned by Mastercard International and is licensed to banks in many countries. Mondex is unusual among bank-owned electronic purse schemes in that individual transactions are not reported back to the scheme owner and transactions between purses are allowed, making it closer to a true cash substitute.	SMSC	Short Message Service Centre
MoU	Memorandum of Understanding	SSL	Secure Socket Layer. A form of data encryption used in computer based transactions
MULTOS	Multi-application smart card operating system	TCP/IP	Transmission Control Protocol / Internet Protocol
NMT	Nordic Mobile Telephone	TDD	Time Division Duplex
OTA	Over The Air. The method used to manage applications on a subscriber handset remotely	TDMA	Time Division Multiple Access (see also CDMA)
PDA	Personal Digital Assistant	TOA	Time Of Arrival
PGP	Pretty Good Privacy. A popular key algorithm	UI	User Interface
PHS	Personal Handyphone System (Japan)	UM	Unified Messaging
PIM	Personal Information Manager	UMS	Unified Messaging System
PIN	Personal Identification Number	UMTS	Universal Mobile Telecommunications System; the third generation mobile standard
PLC	Programmable Logic Controller	USSD	Unstructured Supplementary Service Data
PKI	Public Key Infrastructure	VAS	Value Adding Service
POS	Point Of Sales	VXML	Voice Extensible Mark-up Language
PSTN	Public Switched Telephone Network	WAP	Wireless Application Protocol. Offers internet browsing from wireless handsets
OS	Operating System	WASP	Wireless Application Service Provider
RAM	Random Access Memory	W-CDMA	Wideband CDMA
ROI	Return On Investment	WML	Wireless Mark-up Language
SAT	SIM Application Toolkit	WWW: MMM	Mobile Media Mode
SET	Secure Electronic Transactions: a standard for credit card payment across networks, which does not depend on the security of the network and does not allow the merchant access to the customer's card number. It also links the payment to a specific sale transaction. SET does not require the use of a smart card	XML	Extensible Mark-up Language
SI	Systems Integrator		



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- Industry strategy and strategic business analysis
- Marketing and partnership strategies
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- Setting of product development objectives
- Advice on the development of business plans
- Market intelligence and analysis
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