



The following paper was originally published in the
Proceedings of the 3rd USENIX Workshop on Electronic Commerce
Boston, Massachusetts, August 31–September 3, 1998

Electronic Commerce on the Move

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Abstract

This paper will address some of the business factors and technical developments that are driving electronic commerce in mobile telecommunications. The trend towards mass-market penetration coupled with increased processing power in the handset are evolving mobile networks into one of the primary e-commerce platforms in Europe.

The author will introduce two European pilot programs where the mobile handset—instead of a dedicated PC—is the vehicle for digital transactions. One program known as Smart Access is a service model that uses electronic cash, while a second model in Finland employs intelligent network technology to allow the user to ‘Dial-a-Coke’ from a vending machine and settle the transaction on their monthly telephone bill.

The next section will introduce an aspect of third generation mobile systems known as the Virtual Home Environment (VHE). The VHE is widely considered to be that part of the network architecture where mobile electronic commerce applications or services could reside. The last section will conclude with a comment about mobile electronic commerce.

Introduction

While the classic model of a personal computer hooked up to the Internet via a dial-up connection enjoys the lion's share of research, development and investment in electronic commerce applications or services, digital mobile telecommunications networks like GSM and PCN (the European term for PCS) are coming into their own as viable platforms for electronic transactions. This technical capability is joined by mobile telecomms' penetration into the mass market that far outstrips personal computers in both scale and speed.

Consequently, electronic commerce models are having to consider mobile applications in a new light. More than the fabled network computer, digital handsets constitute the most effective implementation of the thin client paradigm of information services and communications delivery.

But technology is only part of the story regarding the future of mobile electronic commerce. Concurrent with technical advance, the mobile telecomms industry is now a force to be reckoned with on the global stage. The competitive need for operators to differentiate is the main driving force for electronic commerce applications for mobile markets. E-commerce along with information and entertainment services are seen as vital for escaping the current 'coverage-quality-price' competitive model that characterized the build-up of second generation digital systems.

This paper will sketch some of the forces that are changing the basic value proposition of the mobile industry and are opening new avenues for mobile electronic commerce services. It will then describe two Europe-based mobile e-commerce service models: the Smart Access program that is being piloted by AT&T-Unisource, and a trial scheme in Finland for using short-code dialing for vending machines.

These systems are important given that they cover the transaction spectrum of electronic commerce, ranging from anonymous digital cash-based systems all the way to pure credit functions that are being enhanced through mobile networks. This paper will then turn to network and service creation concepts being considered for third generation (3G) mobile systems in Europe. 3G mobile systems place e-commerce functionality at the heart of their business proposition. The aim of this paper will be to introduce some trends and possible scenarios for electronic commerce in a non PC-based, non-North American environment for the USENIX community.

I. Mass market mobile in Europe

A quick glance at mobile penetration figures for the European Union (EU) appears to show nothing but 'good news'. Penetration levels in

Europe as a whole exceed 9%-equating to more than 35m subscribers.¹ This growth should accelerate for the rest of the decade and should not plateau until at least 2005. Salomon Brothers forecasts 15% annual subscriber growth and over 11% growth in annual revenues, predicting that Europe's mobile penetration will exceed 30% within nine years.²

A 30% overall penetration level would place Europe as a whole on equal terms with today's pace-setting Nordic region. Indeed, estimates for these developed mobile markets suggest that future penetration levels of over 50% are feasible.³ Such penetration would place mobile telecomms roughly in the same category as TVs, radios or other mass-market domestic appliances.

Concurrent with wider overall penetration of mobile is more formal attention being paid by the corporate user market, which has begun to view mobile services as an significant part of its overall telecomms spend.⁴ Mobile services are being used increasingly to connect the various organizational 'flavors' found within multinationals-i.e. wholly-owned business units, joint-ventures, supplier/customer trading areas etc.

Yet, as mobile technology inserts itself more deeply into the agendas of major industries and public policy, the basic model that built the mobile industry will be forced to change to meet the exigencies of a mass market. One can expect traditional high-margin, subscription-based revenues sources such as handset sales, connection charges and monthly rental fees to decline in favor of larger (but lower margin) network usage-based revenue sources.

As a result, one can see a gradual amalgamation and rationalization of mobile interests by multinational operators which is a further indication that the mobile industry is becoming similar in structure—and subject to some of the same competitive forces—as many other consumer industries. One can argue that as soon as a telecommunications service becomes significantly unbundled from the network infrastructure and starts moving towards an incremental cost-based tariff, one would expect to see a lot of co-operation, consortium formation and consolidation at the regional level.

It is also apparent that these aggregators will seek to take mobile services further up the info-communications value chain by offering—among other things—electronic commerce services. This is in no small part due to the need to create new avenues for traffic growth and customer retention. E-commerce applications open a new operational mode for mobile services, in effect transforming the mobile terminal into a mediating device for navigating among service providers in addition to being a communications instrument.

There are factors aside from the technical features of mobile terminals that lead many to believe that mobile e-commerce is a natural progression for the industry. The back-end functions of mobile networks are thought to lend themselves to mobile e-commerce. Fraud systems and churn applications—software designed to detect the likelihood of a customer switching to a competitor—are linked with customer care applications into an overall billing architecture that can capture and account for multiple small transactions through 'per-second' billing over the wide area. Moreover, this billing information is analyzed and shared with network planning modules in order to provide a quality of service (QoS) for the entire network.

In addition, mobile service providers regularly host visitors on their networks and have a well developed and scaleable architecture for capturing, handling, accounting for and charging back visitor usage on the network. Clearing houses such as the Luxembourg-based Multinational Automated Clearing House (MACH) are able to offer mobile operators the option of managing their typically 75-80 bi-lateral roaming agreements through a single organizational shell which allows members to settle all of their obligations in a single currency. Other clearing houses such as the London and Washington DC-based Cibernet offer similar types of financial services for operators.

In addition to terrestrial operators, clearing houses such as MACH have signed agreements with the nascent Global Mobile Personal Communications Services (GMPCS) operators like Iridium. In this way, satellite communications users will be able to roam across cellular networks with the same ease as their present GSM counterparts. Given the background of organizations like MACH and Cibernet in clearing call detail records (CDRs), the conceptual jump to substitute anonymous payments is rather straight forward. Thus, from a terminal, network infrastructure and business practice point-of-view, one can argue that mobile telecomms networks are further along the evolutionary path for offering electronic commerce services than many of their PC or fixed-connection counterparts.

II. Mobile e-commerce trials in Europe

The catch phrase for AT&T-Unisource's Smart Access program is "we efficiently sell what the network can deliver". Smart Access is a service concept that enables users to make payments via the Internet by using their smart card with either a PC, a hand-held computer or a mobile phone. Smart Access is based on Internet standards (TCP/IP, HTTP and MIME) and is designed to be integrated with existing hardware and software products or platforms.

Intended for—but not restricted to—transactions of less than US\$10 (where credit card systems tend to be uneconomic), Smart Access is positioned to allow digital goods and services to be sold in precise measures. The cash transaction provides the user with the requested digital product or service immediately, without having to go through a subscription process with the information provider. Smart Access can be thought of as a payment service for companies wanting to sell low-value goods over the Internet in a device independent environment.

In order to move towards an open transaction model, Smart Access had to work in a thin client environment and not just on PCs. Another requirement was that there would be no client-side cryptography. Since smart cards handle consumer security, and since the Smart Access architecture allows merchants, catalogue operators and banks to use as much encryption and authentication technology as they want, no cryptography (and therefore no complex processing) is needed at the client end.

The basic merchant/consumer interaction works as follows. A consumer browses a catalogue and makes a selection. When the consumer has finished making selections and wants to buy, the catalogue checks the selection and generates a bill for the selected goods or services. This is called the Internet Payment Ticket (IPT). The consumer and the catalogue then negotiate a payment choice based on a digital cash systems (for example, Proton, Visacash, Mondex etc.), a negotiation that will conclude with the consumer being directed to a payment server. The consumer then sends the IPT to the payment server and pays with the agreed-upon digital cash.

Once the payment server has received the e-cash, it signs the IPT to form a proof-of-payment Digital Receipt (DR). The consumer sends the DR to a content server to get whatever they selected. The content server checks the DR, knows that it has a valid order and that payment has been made and it can start delivery or anything else needed to fulfill the transaction. The catalogue, content and payment servers are logically distinct and could be physically distinct as well.

So long as the content server gets a DR, it does not care how payment was made. In theory, this means that not only is the merchant able to accept many more payment mechanisms, the merchant may not even know which payment system was used. In this model, the retailer has outsourced the entire payment process to the banking sector.

Among the financial service providers that have partnered with AT&T-Unisource in exploiting Smart Access is Banksys, a subsidiary of Belgium's banks that is the national EFT/POS operator and authorization center. Banksys developed the Proton smart card

scheme which it has subsequently licensed to 14 countries and organizations thus far. In October 1997, Banksys agreed to cooperate technically on the Smart Access project. As a result, Belgian customers are able to pay for digital goods with their local Proton-based electronic purse in their own currency, independent of their location or the nationality of the Internet merchant. Other e-purse schemes such as the Dutch Chipper system developed by PTT Telecom and Postbank as well as the UK-based Mondex scheme have been integrated into the Smart Access service model.

One of the first Smart Access trials was launched in March 1997. The pilot used GSM access to the Internet and the Mondex payment scheme. Participating in the trial were AT&T-Unisource, Apple Computer, Nokia Mobile Phones, National Westminster (NatWest) bank, Schipol Airport, Time Out Magazine and Mondex UK. In the UK, a specially designed web site for Time Out magazine sold information on restaurants and entertainment.

Employees of Apple, Mondex and AT&T-Unisource used the GSM mobile phone link to dial-up the Internet and access the Time Out site. Once there, they could use their Mondex card to pay Time Out for information they wished to see. When payment was made, Time Out sent the information seconds later. Participants were also able to reach a Smart Access banking server to load their Mondex cards over the air by accessing their bank accounts via the Internet. This model was demonstrated further at the ITU Telecom Interactive '97 exhibition in September 1997. Nokia and AT&T-Unisource showcased wireless electronic banking over the Nokia 9000 Communicator by employing many of the same features as the UK trial.

While Smart Access employs a digital cash model to allow mobile terminals to transact for low-value goods, in Finland another transaction model for mobile handsets is being tested by national operator Sonera. The difference between the Sonera project and Smart Access is that Finnish users settle for their selections at the end of the month on their regular telephone bill instead of using cash.

Coca-Cola Drink, a Finnish company that is 25% owned by the Coca-Cola company has introduced the 'Dial-a-Coke' concept with Sonera. Instead of paying with coins, consumers dial a short code telephone number posted on the front of a vending machine and a cola drops out. The charge for the beverage appears on the next monthly statement.

'Dial-a-Coke' grew out of a project to equip vending machines with smart phones that would ring the beverage distributor as the machine ran low on canned drinks. However, the network and distribution costs for such restricted usage did not add up. Instead,

Sonera and Coca-Cola Drink decided to keep the phones inside the machines but expand the possibilities.⁵

The first trial for mobile-phone enabled vending machines was last summer at Helsinki International Airport. However, the transitory nature of users did not allow Sonera and Coca-Cola Drink to draw conclusions and so the pilot was moved to Helsinki University of Technology. After fifteen days of testing the mobile-phone enabled machine, Coca-Cola Drink reported that 31% of the machine's beverage sales came from mobile phones, a significant amount for a new technology.

The 'Dial-a-Coke' concept is being extended to jukeboxes, car washes and is being investigated for road tolls. The service model is heavily dependent on intelligent network (IN) technology that is able to discriminate between Sonera customers and those of rival mobile operators. The network system is connected to a billing architecture that dynamically pays the various commissions to retailers, other mobile operators and Sonera for providing the service.

A major design challenge in the future will involve numbering. By definition, the amount of numbers available to a mobile operator for identifying retail products will be in short supply. As such, Sonera is working with numbering specialists to figure out the best way to get the most number of unique products identified by the fewest numbers in a customer-friendly fashion. Should this be achieved, one can expect that Sonera will continue to find ways to exploit its mobile IN capability to extend its electronic commerce offerings or provide the platform for someone else.

Granted that Smart Access and 'Dial-a-Coke' remain in the trial stages, they are being watched across Europe. The economics of telecomms competition suggest that the trend towards mobile handsets being the main method of communications access will become the norm as mobile service packages are priced the same as fixed-line access in Scandinavian markets. As more European users discard their fixed-line connections in favor of mobile service packages, electronic commerce applications or services will have to be designed or evolved to reflect that market reality.

III. Third Generation Future?

The first third generation (3G) mobile system will be licensed in either Finland or the UK in the spring of 1999. 3G mobile systems were originally proposed as a world-wide standard, combining the services of mobile telephony, two-way radio, paging services and broadband data capability.

The specification for a true 3G system that provides circuit-switched voice and packet-switched data at broadband speeds has

been the goal for the ITU's International Mobile Telecommunications (IMT) 2000 concept. The European expression of IMT-2000 is called the Universal Mobile Telecommunications System (UMTS). A North American proposal called wideband cdmaOne is also competing for the ITU's blessing.

While different in particulars of the air interface and handset chip rates, the two standards promise to deliver voice, graphics, video and other broadband information direct to the user, regardless of location, network or terminal. Data rates of 144Kbps for wide area cellular and up to 2Mbps for fixed installations are specified in both of these standards to meet the IMT-2000 spec.

Concurrent with increased coverage and capacity is an independent service creation environment. This capability is encapsulated in the Virtual Home Environment (VHE) concept. The VHE concept means the delivery of a home operator's total service guarantee—especially for a corporate intranet—to the user at all times, wherever he or she roams in whichever network, public, private, satellite or fixed. The model calls for the terminal to negotiate functionality with the visited network, possibly even downloading software so it can mimic 'home' services in an alien environment.

The VHE network model is joined by new ways of conceiving mobile handset evolution. Ideally, a UMTS terminal should connect to the home environment as soon as it is switched on and the smart card inserted. The intervening networks, signalling, connection, log-on and any other 'technology' should be invisible to the user, so that value-added services that are bundled into the user's demographic profile are easily accessible.⁶

There is also the desire to make terminals and their associated smart card software downloadable over the air so that their standards and operating parameters and supported services can be modified, changed and evolved over time. Software download or software radio are usually described in the context of modifying the parameters of the radio platform (i.e. the radio modem part of the terminal). An example would be the downloading of an improved handover algorithm. This aspect of software download or software radio is generally invisible to the user.

However, there is a completely separate aspect of software download which is more akin to a classic client-server model. This is most easily understood in the Internet context, whereby a content provider or transaction services provider will have a specific applet which is downloaded when the user accesses the services. Examples are audio, video or graphics codecs. The two aspects of software radio will be accessed by different players in the 3G domain. The first aspect will remain the area of network

providers trying to boost performance while the second will be operated by service or content providers.⁷

The VHE network model and software radio are considered to be where wireless e-commerce applications or services will reside. One suspects that in this environment of negotiated functionality, service providers will be qualitatively different from the simple air time resellers that dominate current second generation networks. They would probably resemble service brokers who negotiate package deals with network operators and service providers so that they can offer the user a comprehensive and comprehensible service portfolio at a single billing point.

The extent that this will include transaction capability is not known. However, it is obvious that many of the functions that are currently being trialed in the Smart Access model (for example, the catalogue server) will need to be scaled to reach an increasingly nomadic market that wishes to transact. Moreover, multifunction smart cards that contain medical or insurance data along with digital cash or credit cards can be expected to take advantage of the larger capacity of 3G systems.

NTT in Japan will launch a commercial 3G network in the year 2001 with an eye for global standardization by 2002. The NTT network is being built in co-operation with Nokia and Ericsson according to the European 3G standard. It would follow therefore, that electronic commerce services or applications providers should be aiming to provide 3G specific services before 2005. The degree that these services will be classical shopping or info-tainment or multimedia purchasing or gaming is not clear at this point.

IV. Conclusion

In telecomms markets where prices, service quality and coverage have been geared towards consumer tastes, mobile operators have been swamped with subscribers—something that cannot be said for many other 'Information Society' applications. Additionally, mobile communications are more or less culturally neutral and cut across many more demographic groups than typical Internet applications.

Those cultural factors are joined by the fact that handsets are massively increasing their processor power over the short term. The historic bottleneck in wireless has been the air interface because radio spectrum will forever be a scarce resource. That said, advances in technology assure that mobile data transmission capability will soon outstrip that of the twisted-wire copper network. Even second generation GSM will expand its capacity from 14.4Kbps today to nearly 115Kbps by the end of 1999.

The growing convergence of fixed and mobile networks, coupled with a near universal admission by operators that IP-defined data will overtake voice as the primary communications

traffic, means that the basic economies of scope for offering e-commerce services over wireless media cannot help but increase. Standardization within the IT and telecomms industries suggest that future service models will be device independent and will, in effect, be 'follow-me' service portfolios that track a user as they move across network, service and national boundaries. Terrestrial, radio and satellite systems will be compelled to cooperate to a greater or lesser degree based on a user's particular demographic profile and their willingness to pay.

That willingness to pay, in turn, is largely influenced by the service bundling and ubiquity that a service provider or broker can guarantee for the user. Given that meeting financial obligations is central to living in a market economy, it can be expected that transaction ability should follow a user as surely as dial tone or web tone.

That said, mobile electronic commerce per se remains—like most e-commerce applications—in the trial stage. There is a still a perceptual shift required for people to start depending more on their mobile terminal in lieu of physical cash or coins. 'Dial-a-Coke' is appealing but in the end somewhat limited. Smart Access is a larger step in the right direction, not because it is necessarily the most efficient system, but because it embraces the most diverse range of electronic purse schemes.

The end result for future research will be to define whether or not there are specific electronic commerce applications that lend themselves more to wireless as opposed to wireline applications. In essence, the mobile terminal is the piece of network intelligence that enjoys the most favorable economics for becoming a true mass-market network access paradigm. Therefore, it follows that electronic commerce systems designers would be well advised to look beyond the business models of Internet commerce delivery via a desktop PC lest they find themselves on the wrong side of history.

Notes

1 "Wireless Europe: Every Man and His Dog", European Equity Research Wireless Services, Salomon Brothers, March 1997, p2.

2 Salomon, p2.

3 Salomon

4 Philip Barton, Zeneca Pharmaceuticals, President of the European Virtual Private Network User's Association (EVUA) , interview with author, 10 March 1997.

5 Elina Lahtinen, Mobile Media Director, Sonera, interview with author 6 March 1998.

6 Andrew W.D. Watson, UMTS- Technology Vision Motorola GSM Products Division, Swindon, UK, Chairman UMTS Forum Technology

Aspects Group, presented at "UMTS-The Next Generation of Mobile",
IBC UK conferences, 27 October 1997, London.
7 Watson