Web to WAP: For a Real Start of the New Millennium?

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Our contribution for last year's Bürgenstock conference, The Global Trading Village, was received in a positive manner by risk management professionals and this year's paper should be viewed as a follow-up stressing some of the technical aspects required to move a bit closer to our goal of bringing derivatives to the farmgate in developing countries. As pointed out last year, technology can serve the rich as well as the poor. Indeed, last year's paper aimed at bringing the developed exchanges' attention to the fact that dealing with developing countries at this point in time makes eminent business sense. This year some technical aspects playing a pivotal role in the "democratisation" of technology and information supporting the use of risk management techniques have been analysed. In that context, UNCTAD is currently working together with the World Bank to examine ways and means to reach such a goal. In particular, an International Task Force on commodity risk management has been convened to explore new, market-based approaches to assist developing countries better manage their vulnerability to commodity price fluctuation.

The gist of this paper, having its focus on the technical aspects of the mobile Internet, may be better grasped with a general briefing on information technology. For the developed world Internet has had an immense impact on the whole economy. There have been hopes for the Internet to contribute to global development, with many reports predicting that modern information infrastructure can create the "end of geography" and bring economic progress to isolated countries and regions. Currently, mobile phone system is spreading all over the world, and at the same time WAP (Wireless Application Protocol) is one of the key phenomena of the beginning of the new millennium, allowing access to on-line information from anywhere at anytime. The properties of WAP could be further explored with a specific focus on developing countries needs and potential solutions for bringing derivatives to the farmgate.

For the mobile Internet to contribute to global development, its challenge is to deliver the services that the developing world needs, at a price they can afford. Nowhere is this challenge clearer than in the immense possibilities for risk management and commodity trading which the mobile Internet can bring. Yet without an understanding of the technologies involved, risk management professionals will be marginalised in this process. This paper is therefore aimed at promoting general understanding of the technical issues involved in converting (electronic) e-commerce to (mobile) m-commerce and in building the mobile Internet, and thereby bridging the gap between risk management professionals and the wireless software development community.

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I The mobile Internet

The mobile Internet lets the user access interactive services independently of a fixed line connection and hence, if required, on the move. Worldwide there are 380 million mobile phone users, a number expected to reach at least a billion by 2003, one in six of the world's population. In a classic case of frog-leaping, mobile telephoning is now the preferred mode of communication in many developing countries, permitting many farmers to become part of the modern information society. Already by the end of 2001 half the mobile phones sold worldwide will have some form of net access, with analysts constantly revising their estimates upwards. With a user base in the developed world of this size, mobile telephony is already a major platform for communication. M-commerce, i.e. the use of the wireless Internet to buy and sell goods and services, is not far behind as the 'killer application' of the mobile Internet, predicted by the leading constancy Datamonitor to reach $16.6bn worldwide by 2005. Most commentators therefore agree that significant added value for most enterprises can be gained by delivering a mobile solution. This might be particularly true for derivative trading and risk management in which sector mobile solutions may be especially appropriate. For instance commodity risk management might be able to benefit from an integration between one convenient access point for users and other services relevant to agriculture, such as weather information and agrochemical purchasing (although the latter is undoubtedly complicated by the existence of an intermediate distribution network between consumers and producers).

The mobile Internet offers many benefits including:

- low fixed costs
- immediacy
- personal relevance
- location relevance

But, of course, it currently has limitations:

- latency
- low modem speeds
- low processing power
- small displays
- limited interaction
- limited memory in handheld devices such as mobile phones, pagers and palmtops

The static web cannot offer the services that mobile users are looking for. Generally, people on the move do not have the time to browse, but need personalised information delivered to them in an automatic fashion. The static web is not designed to meet this need, consisting as it does of a billion or more web pages, in a range of languages.

II Currently Available Mobile Internet Services

The mobile Internet is an environment in which personalised information - for example about oilseeds, timber availability, or exchange rate movements – can be "pushed" to users through a mobile device such as a Pocket PC or a WAP phone. However, most of its potential remains unused. Key mobile Internet services currently include:

- access to Internet content
- participation in Corporate IT-systems (origin servers) and Extranets.
- access to personal information, entertainment, media, etc.:
- Intelligent Telephony Services: Carriers can offer their customers secure access to their personal and other customer-related information now located in the carrier customer configuration, billing and other databases in the network

In fact, most of the interactive services (such as information services, such as news or stock prices) that are currently successful on the Internet can be envisaged as part of the mobile Internet. The mobile Internet is also being used to build internal corporate applications, such as company telephone directories, or access to stock data.

However, it is widely agreed that too much focus has so far been placed on relatively unimaginative mobile applications. Of course, there are many new opportunities that mobile device access brings. These might include location-based services or sophisticated telephony applications. There has also been much discussion of the creation of mobile vortals (mortals).[i] Mortals may have great importance in securing customers in the future, especially in their role as content filters. Mortal sites have sprung up, providing news, weather, stocks & shares and more, but there is some doubt about the importance of merely providing information.[ii] The effect has been that the undoubted hype surrounding the mobile Internet is in serious danger of dealing its development a serious setback.

Nevertheless, the technology is already sufficiently well advanced to hint at the great potential for progress. For example, information need not be restricted to news and other text documents. Instead, users could be automatically alerted to the existence of other users whose interests coincide with their own, and be given their e-mail and telephone details. Likewise, unwanted information can be filtered out. This is particularly relevant in the context of OTC markets where numerous offers and brokers may exist.

III The Wireless Application Protocol (WAP)

WAP is a set of open, global protocols for the mobile Internet. The WAP protocols are analogous to many of those used in existing Internet technology, yet are optimised for the challenges raised by small, narrowband client devices (such as mobile phones) and limited over-the-air bandwidth. The static Internet protocols (i.e. HTTP and TCP/IP) are not optimised for the intermittent coverage, long latencies and limited

bandwidth associated with wireless networks.[iii] WAP has been developed to solve these problems, utilising binary transmission for greater compression of data, and is optimised for long latency and low to medium bandwidth.[iv] Handheld digital wireless devices such as mobile phones, Personal Digital Assistants (PDAs) pagers, two-way radios, smartphones and communicators - from low-end to high-end - all use WAP.[v]

WAP protocols are open-specification, meaning that they are discussed, designed, and owned by a democratic consortium of interested parties - the WAP Forum. To quote the Forum "*The Wireless Application Protocol (WAP) is an open, global specification that empowers mobile users with wireless devices to easily access and interact with information and services instantly*." The protocol has within it standards which together define how WAP works and should be implemented, how content is displayed, images represented, security handled and so on. The telecommunications industry ought to avoid duplicating costs and investments through its widespread adoption.[vi]

WAP specifies two essential elements of wireless communication: an end-to-end *application protocol* and an *application environment* based on a browser. The *application protocol* is a layered communication protocol that is embedded in each WAP-enabled user agent. The WAP standard also specifies an image format called WBMP (Wireless Bitmap).[vii] With respect to the *application environment*, WAP takes a client-server approach, incorporating a relatively simple microbrowser into the mobile device, thus requiring limited memory resources. The microbrowser is also capable of communicating with any WAP user agents. Whilst familiar browsers such as Internet Explorer or Netscape interpret HTML pages on a PC, there exist WAP micro-browser equivalents[viii] designed to run on a handheld device and to interpret WML (Wireless Markup Language).

WML is one part of the WAP specifications - analogous to the HTML language used to build Internet web pages.[ix] WML is used to specify the format and presentation of text, hierarchies of screens (known as a 'deck'), and hyperlinks between those screens (or 'cards'). Essentially it is possible to produce WML pages in exactly the same way as HTML (which is used by mobile devices such as Pocket PCs running Microsoft Windows CE 3.0) but the language is optimised to deliver large quantities of data to the small screens of mobile device. WML will thus make it much easier to deliver financial product suites. On the other hand, WML provides for fairly limited page sizes.[x]

WAP does have its limitations, which can be illustrated by comparison to a proprietary wireless based architecture such as realtime equity and derivative data specialist Worldlink's Virtual Cable.

Firstly, a push operation (e.g. streaming real-time data to a device rather than having periodic user refreshment) is not specified by the protocol currently[xi] used by the WAP gateway server.[xii] The support of pushes on the client side depends on the capabilities of the microbrowser on the client's handset to manage pushed content.[xiii] Worldlink, on the other hand, can use Virtual Cable to push data to its clients, and thus avoid the lack of support for dynamic programming languages, speed constraints and unreliability of, for example, web based feeds. Secondly, WorldLink's layered messaging architecture incorporates industry standard encryption wherever needed.[xiv] WAP's

encryption standard is deficient. One of the layers of the WAP stack, known as WTLS, provides only imperfect encryption and authentication for server-to-client security.[xv] Finally, downloadable unit sizes are small because WAP incorporates no compression techniques for the textual content, although WML markup commands are compressed. This means that applications need to be specifically designed to be very code-efficient by using templates and variables and keeping information on the server and using the cache on the phone. A VPN such as Worldlink's Virtual Cable, by comparison, does allow efficient transmission of the full service. Only if these problems are overcome, companies such as Worldlink may decide to move to WAP.

IV Mobilising the static web: conversion

With about a billion static web pages, rising continually, converting static web content to a usable format for handheld wireless devices is clearly *the* challenge of 2000. It is possible for a mobile device to connect to a static Web server through a WAP gateway located in the mobile operator's network. Technically, there are then two different approaches. The first is to *convert* existing static web pages into compact HTML, HDML or WML.[xvi] The second approach, discussed further below, is to create specific WAP content.

Conversion can either be once off using a package such as Spyglass Prism, or on-the-fly by a WAP gateway filter. Dimon's WAPorizer, for example, is capable of transforming any current website to WAP.[xvii] The conversion process, though it can deal with large and complex web sites, still takes a matter of days, but with this system is performed only once. Once the relationship between the HTML and WML sites is defined, such products automatically updates the WML pages to reflect changes in the existing web site. New web pages are directly incorporated into the translation. It is also possible to *reverse*, and convert static and dynamic (ASP, CGI, Java Servelets etc.) WML documents to HTML documents. A WAP browser is still currently not bug free, and it may not ever be. The script fetches pages from WAP sites, and converts them to HTML (web pages) "on-the-fly". This means that the developer can view most WAP pages, but some pages, especially those with a lot of input forms, are very difficult to convert to HTML.

This approach, though admittedly popular, is at least at present not satisfactory. The content designed for a PC is not ideal for a mobile device. Whilst there may be masses of "static" web content today, this will not be what turns up on WAP phones; static web content, especially non-dynamic content, is not suited to the medium. And as the current generation of WML is designed for small screens, and therefore not as visually rich as HTML, any conversion will compromise a great deal of the HTML content and formatting. Only simple HTML pages can be converted satisfactorily.

Furthermore, conversion is not a straightforward issue that can be solved by an off-the-shelf package in every case.[xviii] For example a WML service will not necessarily work from a static web WAP simulator to an active mobile device.[xix]

V Creating WAP content directly

The second more forward-looking approach is to *create* content specifically for a mobile device in WML: personalised, timely, and locationally specific. WAP is not web and therefore applications have to be totally redesigned. To some extent this is a designer's guessing game: what will the mobile Internet user want differently from a PC user? It is already possible to build a three page WAP 1.1 site directly: home page, contact page and services page.[xx] Here, the approach is to log in through a PC to the static web, and use the firm's website to create a WAP site, adding text and graphics and then publishing. Virtual Internet claims that their WAP site builder enables a user to build a multiple page WAP site, even with no knowledge of programming, in under 15 minutes. The next stage is WAP 1.2 and construction of a WAP site from a WAP smartphone itself, which is clearly being planned.[xxi] All the major handset manufacturers[xxii] already have developer aids and basic programs.

WAP development tools

In such a fast-moving technology as WAP in 2000, this can only be a brief snapshot of what is available. The best advice that can be given is to research available tools through the Internet where they are collated, many of them through www.anywhereyougo.com. At present, as an example, Nokia's WAP server allows developers to offer Internet - or Intranet -based information and services to their customers, business partners and employees through a mobile device. The company claims that this 'provides an exciting opportunity to distribute existing services and to develop totally new ones. With this platform, companies can offer content and services that create strong brand presence both in consumers' minds and in the marketplace through mobile devices'. For further information, please consult www.nokia.com/corporate/wap [1]

Guidelines for WAP site design

To test what the possibilities for using WAP and WML to operate a site, the Irish firm wapprofit.com established wapmanutd.com in November 1999. The site has been updated 2-5 times daily since the start of December and is a high traffic open access sites on the WAP. Wapprofit has already outlined conclusions for WAP site design, partly based on their experience from wapmanutd.com. Their three main conclusions are:

1. Do not underestimate the traffic.
2. Update the site often and keep the pages short.
3. Make the content relevant and different.
4.Test the pages cross browser and stick to templates

VI Intelligent Search and Personalisation for the mobile Internet

Mobile applications increase the stress on measuring interactions with the user, analysing them and executing changes/campaigns as a result. Key questions for the applications of the future therefore include: the measurement of the success of the application, whether the loop can be closed on pro-active messaging, whether campaigns can be tracked and whether it is possible to analyse and personalise on user/time/place and transactions.

The usual static net search engines have made claims that they are key to solving the "loads of content - very small screen" problem - but critics suggest that they have done little other than re-position themselves onto mobile devices without making structural changes to their operation. However, a number of companies such as Bright Station and Autonomy has specialised in improving the basic static web search engines. Vendors including Autonomy, Calico Commerce and PointServe provide services such as point capability and order configuration. Autonomy, for example, specialises in analysing and extracting ideas from text. Their products profile users based on the documents they read and produce, and then actively deliver information that matches this profile. Autonomy's products can trawl and look for combinations of words and ideas and concepts, e.g. scenario (neural network technology) will try to match using sophisticated algorithms - e.g. legislation.[xxiii] The technology can analyse text and identify the key concepts within the document because it understands how the frequency and relationship of terms correlate with meaning. Because the technology does not rely on key words, it can work with any language. It is not foolproof but a range of clients maintains that it represents a qualitative advance from a word search engine. Users who search constantly for information on oilseeds, for instance, will receive information based on this profile.[xxiv]

These products are increasingly being extended to deliver content in a WAP format. As Autonomy state, their I-WAPtm "*has been specifically developed to address the limitations of today's wireless information delivery*". As these limitations ease, applications such as personalisation and intelligent search will become much more relevant to the mobile Internet. "*What is difficult is developing the business rules so that the personalised content is structured for a WAP display*" (Matt Price, European Marketing Director at ATG). Yet this personalisation and intelligent search is clearly vital for derivative trading and risk management. The oilseeds farmer needs to have delivered only the information that is relevant, such as local weather, farmgate or processor prices, and available hedging instruments. There is otherwise a clear danger that the mortal as the single point of interaction between the user and the mobile Internet will be swamped with information, even about oilseeds, and no decision will be easy to take. This will be especially the case if mortal designers fail to pay adequate attention to the ergonomic aspects of mortal design, such as symbolism, language, voice interface, and m-commerce community building.

VII The Future

A term that gained prominence in 1999 was the concept of "Unified Messaging". Weeks of Grey Interactive suggests "Unified Access" as an alternative term. With "Unified Access" is meant that we are no longer in isolation when using a particular mobile or static device. We should be able to access our chosen service via WAP, via the static web, via fixed voice line, via mobile voice line, or via e-mail. Development is in an initial stage here, and it was argued that perhaps global connectivity should be examined from a much more holistic viewpoint. Wireless applications will have to seamlessly integrate and synchronise, not only with their web counterparts but also with interactive TV and any other necessary channels, which might be available in developing countries.[xxv]

Of course, there are many impediments for these countries such as the relatively greater importance of the mobile phone by comparison to the PC and the static web, but commensurately traditional channels such as conventional broadcast radio might have a greater part to play, even if only to steer users to appropriate mortals. Secondly, many analysts believe that pro-active notification services are key to the mobile Internet: SMS messaging was an early example, but WAP push is the future. The user needs to be brought into the net at the right time. Thirdly, blending WML and VoxML (voice IVR) applications will be an interesting next step, and especially important for developing countries with numerous languages and no universal knowledge of English, French or Spanish in particular; but devices need to change for this. The capacity of the mobile Internet to provide all these functions is increasing rapidly, and further improvements are on the horizon.[xxvi]

Will WAP in future versions remain the dominant protocol of the mobile Internet? As users begin to voice their dissatisfaction over what is predominantly seen as a highly technical protocol without necessarily considering the best interests of the consumer, doubts about the likely short-term success of the mobile Internet are widespread. Of course, almost every major new technology has had to deal with more than a few hiccups upon launch. The web took the best part of a decade to become a viable place to do business. And the Internet itself has been around for longer than most of the people who use it, in fact since its military beginnings in the 1960s. Both the static web and the Internet have had more than their fair share of detractors over the years, but it has not prevented them from becoming the dominant new business idea of the past decade.

WAP was designed primarily to help overcome the limitations of what is at present an extremely unfriendly medium for the delivery of interactive services. As the medium gets friendlier, especially with the arrival of 2.5G and 3G, will the world need WAP? Some analysts suggest that it will be completely replaced by a fresh protocol, but this claim is reminiscent of similar claims about MS-DOS and Windows. More likely successive versions of WAP will be subsumed into already well-advanced initiatives. [xxvii]

The over-riding fact of the mobile world is that service providers will have near constant access to a unique individual person. A new breed of mortals will emerge which are optimised for speed and mobile delivery. An example already is europewap.com. In order to properly serve this unique individual person a unique individual service is required. Of course, personalisation is rife on the web but it is only the veritable tip of the iceberg and at present is user-driven rather than intelligently managed by the service provider themselves. To properly serve their customers in the mobile Internet, wireless destinations will need to know and understand their customers and how their needs and wishes are changing. Customer Relations Management solutions tied to wireless services will be paramount and a human being behind it all essential. For network and content providers, this kind of service enables far greater interpersonal differentiation and hence more sophisticated targeted products. Back-end manual information management costs ought also to be reduced.

VIII Conclusion: transactions the 'killer application'

Little work has been done to date on making the WAP or wireless as a whole a forum for real m-commerce, but there is, in principle, no reason why WAP cannot be used as the basis for transactional WAP sites. Some already exist, for example a timber spot market, and the early adopters who have real transactional WAP and m-commerce sites might have significant first mover advantage and spin-off loyalty benefits as early users might enter these sites into their WAP phone memories maybe just once. This might be the killer application for m-commerce, utilising specific WAP software.

In the context of risk management, the parallel between user-driven intelligent personalisation, possibly including voice interaction, of access to derivative markets and their brokers, and the rise of the OTC market by comparison to exchange traded products is clear. The opportunity exists that derivative trading volumes could therefore rise further as a result of such services. Some estimates suggest that widespread implementation of the mobile Internet for commodity transactions could *double* commodity derivative risk management trading volumes.

Endnotes

[i] Vortals are vertical market portals on the static web. They can be generic vortals, such as Freeserve and T-Online, or could serve a specific public.

[ii] Additionally, there is room for technical improvements. Most of the mortals are linked to individual ISPs; some, such as the original BT Genie service in the UK, requiring separate connections for each type of information.

[iii] HTTP, for instance, sends its headers and commands in an inefficient text format instead of compressed binary.

[iv] A competing system is i-Mode, a proprietary service available in Japan - the world's second largest cellular phone market but less of a PC market than the USA or Europe. This system works over Japan's CDMA network (WAP in Europe mainly uses the GSM network). It uses a compact version of the static web's mark up language HTML to display content on an 'always-on' basis and has enjoyed very considerable success in Japan. By early 2000 there were over three hundred specially formatted websites linked to the network, as well as thousands of unofficial ones. NTT DoCoMo (nee i-Mode) are already talking to the WAP Forum and companies in Europe about basing 3G services in part on the i-Mode technology, so it is far from the bounds of impossibility to see the two protocols synthesise in due course.

[v] The WAP standards make no assumptions about the target client other than their size and bandwidth restrictions. Fortunately, the addition of WAP functionality in mobile devices does not greatly affect their price of manufacture. WAP is designed to be flexible enough to work with most wireless networks such as CDPD, CDMA, GSM, PDC, PHS, TDMA, FLEX, ReFLEX, iDEN, TETRA, PHS, DECT, DataTAC, and Mobitex, and will include future third-generation standards. In terms of operating system compatibility, as a communications protocol and application environment, WAP can be built on any operating system including PalmOS, EPOC, Windows CE, FLEXOS, OS/9, JavaOS etc. As long as there is a WML 'micro-browser' available for it, any OS can be used, and it provides service interoperability even between different device families.

[vi] http://www.wapforum.org.

[vii] WBMP Type 0 is a simple black and white, uncompressed bitmap; if a WAP device supports any graphical images at all, it must support this WBMP Type 0 as a minimum.

[viii] Microbrowser-based services and applications reside temporarily on servers, not permanently in phones.

[ix] An alternative and somewhat older system (introduced in May 1997 by Unwired Planet) is HDML (Handheld Device Markup Language) Specification. The full specification can be found at www.w3.org. This was, for a few years, the dominant system: in the US and Canada many of the commercially available CDMA and CDPD phones only support HDML. HDML and WML share the same basic programming model and functionality, but unlike WML, HDML is not XML-based. It should be stressed here that the main benefit of being XML-based is that a company can use any of the many commercially available XML tools to generate, parse and manipulate WML, and can also use XSL/XSLT to construct WML decks from XML meta-languages. Also, HDML does not allow scripting, (e.g. JavaScripters), while WML has its own version of JavaScript. After the introduction of WML, HDML is losing in popularity. In Europe and Japan, some WAP devices already do not accept the HDML format. It is most likely that the future US and Canadian smartphones will all support WML also. Phone.com's UP.Link platform continues to support applications written in HDML, but is recommending to its users to move to WML. The current most recent WML Specification can be found at www.wapforum.org.

[x] As an indication, compiled pages must currently be kept under just 1,400 bytes. This may prove to be an incentive for new HTML and XML-based languages to be developed.

[xi] WAP 1.2 does provide some functionality in this area, indicating that further advances may be ahead.

[xii] A WAP gateway is a software entity within the mobile network. It connects to the Internet or an Intranet in order to allow content and applications to be sent to WAP-enabled phones.

[xiii] This requires it to handle Java Applets and Active-X, which is not currently possible on any microbrowser and would require the development of raised operating systems, programming languages and applications.

[xiv] This prevents fraudulent access transactions and opens the way in principle for m-commerce and intranet-type applications.

[xv] Due to premature encryption endpoints (i.e. between server transfers) at points of data transfer, it is possible for a proxy server to have access to decrypted data. Whilst this might not be an insurmountable problem for small transactions where there is little incentive to decrypt, for larger ones it will remain an issue.

[xvi] Particularly important is the conversion of HTML to WML, which with a typical system will run with Internet Information server (IIS4 and IIS5) on Win-NT4 and Win2000. With such a converter it is possible to validate any WML document so it is correct before it is sent to the mobile device through a WAP gateway.

[xvii] Written in Java, WAPorizer resides in a user-specified location between the mobile users and the actual websites, for example next to the WAP gateway itself; on the web server where the content lies, or installed at a third party anywhere in the world with an Internet connection. WAPorizer supports SSL encryption for secure m-commerce transactions across mobile phones; and it has password management features that prevent automatic relogin by phone users - a security risk if the phone is lost or stolen - and comes with a graphical interface allowing web administrators to manage their own translations.

[xviii] One reason why file conversion is not a straightforward matter is the differences, which exist between operating systems for mobile devices. Symbian, the consortium of mobile phone manufacturers including Ericsson, Motorola, and Psion, would like their operating system, Epoch, to be universal. Others such as Sony use their own proprietary browser, STNC. Then there is Microsoft which has been working hard on its Microsoft CE operating system, and working on a range of devices known as Pocket PCs such as the Hewlett-Packard Jornada, Casio Cassiopeia, Compaq Aero and Compaq iPAQ. So there are significant interoperability problems, particularly since there are different firms' interpretations of WML. Content providers must constantly consider this. Firms such as Argo plc specialise in providing interoperability, taking an output-device specific WML and adapting the relevant page to fit onto an another device with a different screen size and colour specification.

[xix] Access to electronic systems using an XML interface require some form of common language, for example information might arrive in XML format but the output is required in WML for a WAP phone, HTML for a CE device or another relevant conversion. Consequently a mortal platform will need a transcoder to sift through the numerous feeds arriving at the server - possibly over a hundred - and to redistribute them appropriately in the correct language to mobile device sites that, currently at least, do not have the processing capacity to retain such logic locally. Fortunately transcoding is not charged by user, but is a cost borne at the server level.

[xx] This is for instance represented by large firms such as Virtual Internet www.vi.net/wap.

[xxi] Products exist such as the SmartPhone Emulator Web Site Edition which is a lightweight WAP handset emulator capable of supporting different phone personalities. WAP developers use the desktop edition of emulators to preview WAP applications from their desktop in the knowledge that the emulator provides a reproduction of the actual mobile device products. Most emulators allow support for new mobile devices as they become available. In many cases the emulators are bundled with a collection of simple command-line tools (WML encoder, WMLScript compiler) for integration into the existing development environment.

[xxii] Nokia, Motorola, Phone.com and Ericsson.

[xxiii] Autonomy's architecture combines pattern-matching algorithms (non-linear adaptive digital signal processing) exploiting neural network techniques originally developed by Neurodynamics, combined with contextual analysis and concept extraction to automate the categorisation and cross-referencing of information, improve the efficiency of information retrieval and enable personalisation of digital content. The architecture performs four main functions: concept matching between documents, agent creation, encoded representation of ideas, agent retraining using successive texts and finally a standard text search.

[xxiv] Vignette, by comparison, is a personalisation engine, which sets up rules and dynamically generates content. Similar products are provided by Broadvision, Personify, Art Technology Group, Netcentric and Informix.

[xxv] An example of the developments in this direction is Bluetooth, a wireless technology that lets devices such as phones, computers, printers and handheld PCs communicate with each other. Bluetooth has been in development since 1998, when companies including Ericsson, Nokia and Toshiba formed the Bluetooth consortium. Since then, more than 1,800 companies have signed up to the development. Products will be shipped to users in the fourth quarter of 2000, and it has been estimated that there will be more than 670m Bluetooth-enabled devices on the market by 2005. Ericsson, the Swedish mobile phone manufacturer, said that all of its phones would feature WAP as a standard from 2001. The company is also introducing the Bluetooth PC card, which will enable users to have a wireless connection between their mobile phone and laptop, and makes it possible for users to transfer data, such as a contact list or a diary, between their phone and computer.

[xxvi] New technologies known as 2.5 and 3G enable operators to send data over their networks at higher data rates to handsets equipped to receive such data. GPRS, for example, is a new over-the-air service that transmits data packets to hand-held devices on a 'send-when-new' or 'always-on' basis. It will allow much faster WAP transmission than currently available over SMS or CSD when using GSM, and allows GPRS handsets (like the Alcatel One Touch 700) to receive data at rates up to 115Kbps - though one can expect slower rates in practice. In Japan, 3G will take the form of WCDMA, an upgrade to the existing CDMA network (the W standing for wideband). This will allow data rates of up to 2Mb to handsets equipped to receive such data. Apart from its capacity to provide new products, this new technology avoids the slow “dial in” of current GSM technology; the handset is not 'always-on' (compare dialling in from home versus network access from an office). It is to be noted that i-Mode is 'always-on' and this has helped enormously with its adoption. The 'always-on' aspect of GPRS and beyond makes real time mobile applications - such as trading transactions - possible. Until then, the value of the information must be high to make it commercially viable. In terms of timing, 3G can be expected from 2001-2003 in developed countries. By then, rapid data access will be in high demand. There will be massive demand for WAP and other forms of wireless internet access as the supply of phones emerges. The mobile Telcos will rapidly bring forward their plans for high speed mobile data networks: many are in full trial now - some 18 months earlier than planned in 1999.

[xxvii] One leading developer has suggested that the current versions of WAP are to the mobile internet what Gopher was to the web: an interim technology. In theory, WAP could be removed when phones become native IP devices (as PCs are today). Some developers are already suggesting that since WML will be replaced by HTML directly, or XHTML, in future versions of WAP, converters will become redundant as mobile applications will be written in HTML/XHTML itself, depending on whether the mobile device manufacturers want this. Why not start developing mobile applications with HTML/XHTML now? It may then be expected that the application server platform providers - Oracle, Lotus, IBM, will be able to use heavyweight web servers to produce dynamic mobile content. Sony's launch of their CMD-Z5 mobile phone is a case in point. The CMD-Z5 supports WAP but it also supports HTML based delivery and a whole host of technological must-have features. Samsung and other manufacturers also are launching similarly equipped phones. With the launch of Microsoft's new WindowsCE 3.0 palm devices, we also now have devices which have much larger colour screens and more processing power than conventional WAP phones, although they are at present still expensive and - very importantly in the developing country context - still quite fragile. In addition, there are other potentially interesting products from Psion and Handspring to consider.