WAP—The catalyst of the mobile Internet

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Ericsson is actively helping to shape the mobile Internet industry with enabling technologies, such as WAP, Bluetooth, EPOC, Parlay, GPRS, UMTS, and associated products. In particular, the wireless application protocol is an early enabler with the potential both to offer and unlock value in the emerging mobile Internet industry. In fact, WAP is probably the one technology that will kick-start the new industry and open the doors of opportunity.

The author describes the new wireless paradigm with its emerging business roles and opportunities. He then provides a brief background to WAP and goes on to compare it against competing technologies and solutions.

The mobile Internet industry—Opportunity knocking

A new wireless paradigm

Mobile communication and data communication are two of the fastest growing areas in the communications industry. In particular, mobile data communication, which includes wireless Internet, carries a great deal of momentum. The media is keeping a vigilant eye on the evolution of wireless data, and operators and various kinds of enterprise have put wireless datacom at the top of their strategic agendas.

Wireless data communication combines mobile communication and data communication by giving consumers easy access through mobile phones, pagers, or other wireless devices to relevant information on the Internet and intranets.

Operators see wireless data communication as an opportunity to create innovative services on top of existing networks and investments. Doing so will give them a means of differentiating themselves—for instance, to enhance their business image, reduce churn, attract new subscribers, and increase traffic volume per subscriber.

Enterprises are increasingly looking for ways of increasing employee productivity. Wireless data will enable professionals to access corporate data, such as e-mail, production status, price lists, and other critical information for doing business while they are away from the office. Specific vertical segments, such as financial institutions, have expressed interest in wireless data as a way of distributing services. In this context, wireless data would improve their overall image and increase the availability of services through a rapidly growing low-cost distribution channel. These needs and initiatives from Ericsson and others, have created "phone browser technologies," such as the wireless application protocol, or WAP.

New business roles for operators

The mobile Internet market is being formed by the intersection and merger of the wireless telecommunications and Internet industries. In this realm, which is still very much characterized by transition, the rules of the game are changed and several traditional value chains have been upset. Consequently, on entering this realm, many players feel uncertain of their role. Ericsson has carefully evaluated the situation and identified a number of emerging business models that operators can adopt to position themselves in this turbulent market. Although the business models of the mobile Internet are similar to those of the Internet, some differences have been identified (Figure 1):

- The role of portals to the mobile Internet is more prominent than that of portals to the traditional Internet.
- The emerging classes of service will have more impact on the success or failure of the mobile Internet than mobility-enabling technologies.
- The mobile Internet represents a major opportunity for electronic commerce (e-commerce).

Thanks to their important assets, such as large customer bases, gateways between mo-

BOX A, ABBREVIATIONS AND DEFINITIONS

Bluetooth	Universal radio interface for *ad hoc* wireless connectivity
CDMA	Code-division multiple access
CDPD	Cellular digital packet data
CSD	Circuit-switched data
EPOC	Operating system developed for use in mobile devices
ETSI	European Telecommunications Standards Institute
GPRS	General packet radio service
GSM	Global system for mobile communication
HTTP	Hypertext transfer protocol
IDC	International Data Corporation
IETF	Internet Engineering Task Force
IP	Internet protocol
ISP	Internet service provider
LAN	local area network
OS	Operation system
Parlay	Name of application program interface—a specification designed to enable carriers and independent software vendors to write applications for providing services across wireless networks, IP-based networks, and the PSTN.
PCS	Person communication services
PDC	Personal digital communication
PoP	Point of presence
SIM	Subscriber identity module
SMS	Short message service
TCP	Transmission control protocol
TDMA	Time-division multiple access
UDP	User datagram protocol
UMTS	Universal mobile telecommunications system
USSD	Unstructured supplementary data
W3C	World Wide Web Consortium
WAP	Wireless application protocol
WML	Wireless markup language
WTA	Wireless telephony application
XHTML	Extensible hypertext markup language
XML	Extensible markup language

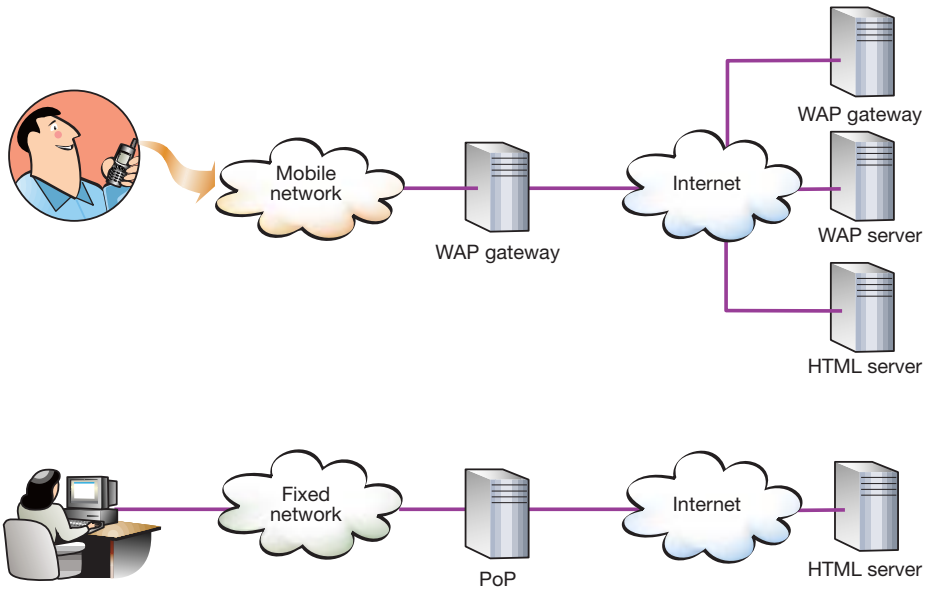


Figure 1
Comparison: Access to the Internet via WAP and over a fixed-network connection.

bile networks and the Internet, billing and invoice systems, and control over mobile terminals and networks, wireless operators are well-positioned for success in the emerging wireless data industry (Figure 2 and Box B). Mobile operators who choose to capitalize on their position in the emerging industry will open wireless portals that incorporate e-commerce and transaction centers. By doing so—and in particular, by adding WAP-enabled services that fulfill end-users' needs—operators can

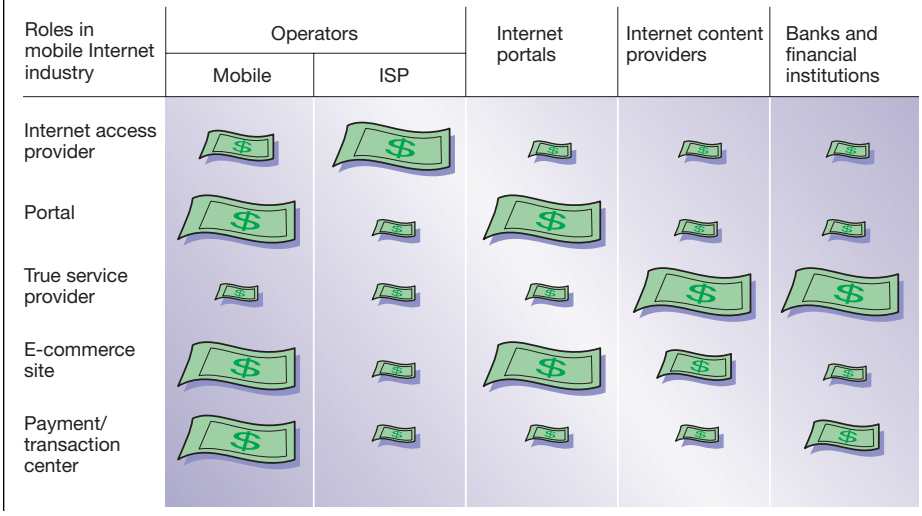
- differentiate themselves from the competition;
- reduce churn, thanks to customized user profiles;
- improve their overall business image; and
- enjoy large increases in datacom traffic.

WAP—what is it?

The wireless application protocol is a suite of specifications that defines a protocol for communication between server applications and clients; how specific functions in the mobile device can be used at the client's current location; and an enhanced markup language for wireless applications—the wireless markup language (WML). The specifications have been drafted with the aim of

- becoming a global standard that is not restricted to any particular cellular standard;
- being optimized for narrowband bearers;
- being optimized for handheld devices with limited capabilities, especially in terms of the user interface; and
- integrating telephony services with microbrowsing.

Figure 2
Operators are well-positioned to make money in the new wireless data communications industry.



The wireless application protocol is specified by an industry consortium—the WAP Forum—which was founded in December 1997, by Ericsson, Motorola, Nokia, and Unwired Planet. The consortium, whose membership is open, currently has approximately 250 members. The work of the forum is divided among working groups and committees that oversee the work and ensure that the specifications do not drift apart. In short, the WAP specifications cover

- the microbrowser;
- scripting;
- wireless telephony applications (WTA) and a WTA interface to mobile devices;
- content format for applications; and
- a layered stack, which includes application, session, transport, and security layers.

The WAP gateway, which terminates WAP on the server side, can be located at the site of the mobile operator, independent service provider, or enterprise. Different locations offer different advantages. If located at the operator's site, end-users can enjoy faster access, customized billing solutions, and specific network features provided by the operator. If located at the enterprise, end-users can use the standardized security layer for end-to-end security when they access bank services or services within their corporation.

Today, WAP 1.1 products have been rolled out and several operators and service providers have launched WAP 1.1-compliant gateways and servers. WAP 1.2, which includes features like PUSH and wireless telephony applications, was recently completed and related products are expected to appear on the market this spring.

The future roadmap includes work on combining WAP and Bluetooth, converging WML with the extensible hypertext markup language (XHTML), and on making WAP and smart cards fully compatible.

A sure bet

WAP is an open standard that has been optimized for mobile environments with limited bandwidth and small screens, making it the first major enabler of a truly broad deployment of wireless data.

Several technologies are competing to become the dominating standard for wireless information and Internet services, but numerous indicators suggest that WAP will predominate: WAP represents superior technology that has been optimized for mobile environments. WAP has gained the support of operators, telecommunication and data communication suppliers, and a variety of corporations. Moreover, WAP does

BOX B, DEVELOPMENT OF BUSINESS MODELS IN THE MOBILE INTERNET SPACE

Role	Description	Business model Internet	Sources of income in mobile Internet
Access provider	• ISP or wireless access provider	• Monthly fee or usage-based • Advertising revenues	• Fee for selected operator-based service – reduced churn • Monthly/usage fee for value-added services • Monthly fee or or usage-based fee for surfing/ external services • Flash/rolling ad revenues
Portal	• Page referring to other pages	• Advertising revenues • Link hosting	• Flash advertising/rolling ads • Co-branding with Internet portal – revenue captured on the Internet portal
Content provider	• Content on Web page	• Advertising revenues • Brand building • Cost-saving distribution channels	• Flash advertising/rolling ads • Cost-saving distribution channel • Brand building
E-commerce site	• Shopping possibility via Web page	• Revenue share of transaction	• Revenue share of transactions
Enterprise intranet/Internet	• Information or applications on Web pages	• Improved productivity • Closer tie-up to customers and suppliers	• Improved productivity • Closer tie-up to customers and suppliers
Payment/transaction center	• Entity where subscribers can have accounts from which to issue payment	• Role assumed by credit card companies/banks • Percent on transaction volume	• Role could be assumed by operator • Percent on transaction volume

not compete head-to-head with other technologies.

The main contending technologies are Windows CE (Microsoft/Wireless Knowledge), Palm VII (Palm Computing), I-mode (NTT), and the SIM-Toolkit (Schlumberger). The unquestioned leader today among these contenders is I-mode, which already has several million end-users and a broad content portfolio.

WAP

The objective of WAP is to provide an open standard for access via a mobile device to the Internet or intranets. Because WAP has been optimized for mobile environments, it makes optimum use of restricted conditions, including small screens, limited device memory, and limited bandwidth availability. Furthermore, WAP operates with existing networks and will be compatible with future standards for third-generation wireless systems and XML/XHTML. The WAP Forum has established relationships with the European Telecommunications Standards Institute (ETSI), Internet Engineering Task Force (IETF), and the World Wide Web Consortium (W3C).

WAP enjoys the greatest support of all contending technologies. Most leading players in all affected segments (handset manufacturers, operators, content providers, application developers and system integrators) support WAP. In addition to Ericsson, a few principal members of the Forum include Alcatel, AT&T, IBM, Microsoft, Motorola, Nokia, Oracle, Phone.com, T-Mobil, and Sun Microsystems.

Microsoft/Wireless Knowledge

With its sights set on positioning Windows CE as the preferred handheld operating system in the wireless market, Microsoft entered into a joint venture with Qualcomm, forming Wireless Knowledge. Three operators, BT (Europe), NTT (Japan) and Nextel (USA and Canada), have been given the exclusive rights to test Microsoft products in their respective geographies.

More recently, Microsoft has joined the WAP Forum and publicly pledged its support for WAP, vowing that its microbrowser and all future Microsoft products will support WAP. Ericsson and Microsoft also recently formed a joint-venture company with the aim of further developing the WAP standard. In light of these developments and thanks to Microsoft's vast experience of developing software applications, WAP can safely be regarded as a sure bet.

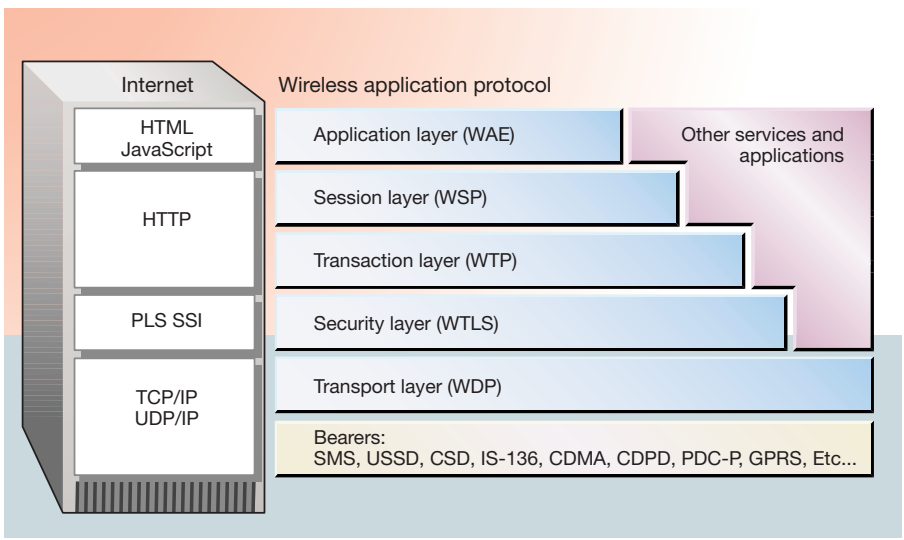
Palm VII

The Palm VII is a Palm PDA that is based on the Palm III with a built-in wireless modem—a Mobitex modem. Using a proprietary technology, called *Web clipping*, Palm Computing offers users the ability to access specific content on the Internet over BellSouth's Mobitex network. Palm calls this service *Palm.net*. In brief, Palm believes that users of handheld devices are not really interested in surfing, but want access to specific services, such as ticketing services or traffic information. Palm also offers an e-mail application for the Palm VII.

One of the main differences between *Palm.net* and WAP is that a WAP user can browse any website that handles WAP. *Palm.net* users, on the other hand, can solely access those sites that have been stipulated via a Palm Query Application, which must previously have been downloaded to the Palm device. Another main difference is that once WAP applications have been developed, they can be used over any network—Mobitex, GSM, PCS, TDMA, and so on.

Numerous applications can be run on top of the Palm OS, including WAP applications or applications for accessing a compa-

Figure 3
Comparison of architectures: the Internet versus WAP.



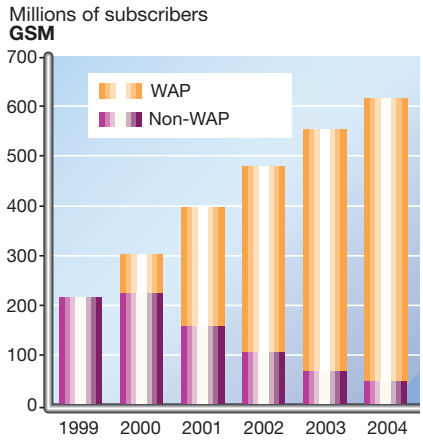


Figure 4
Estimates of WAP penetration into GSM. Note: These estimations assume WAP interoperability, WML application development, and the availability of WAP-enabled phones.

ny LAN. Qualcomm is currently working on a solution that uses a cellular phone as a modem for Palm devices. IBM is working on a solution that will enable Palm users to access Lotus Notes using WAP. Similarly, Ericsson has released a WAP browser for the Palm OS. Palm joined the WAP Forum in July 1999.

I-mode

I-mode is a Japanese solution that is actually fairly similar to WAP. To date, I-mode is the most developed solution in terms of functionality, service response time, and deployment. However, its potential to become a standard is limited, since its only supporter is NTT, and it can only be used on PDC networks.

The commercial launch of I-mode took place in the spring of 1999. By August, I-mode had attracted one million subscribers, with additional subscribers signing up at a rate of 90,000 per week. This fantastic success can be attributed to three factors: several end-to-end solutions, attractive pricing models, and a large customer base (25 million end-users).

NTT was able to launch I-mode very quickly because it has full control over the mobile terminals and networks. Also, thanks to its extremely large customer base, NTT was in a position to dictate to Japanese content and service providers what services would be offered via I-mode.

Besides I-mode, NTT has also pledged its support for WAP. In fact, NTT states that it will use WAP technology in its corporate solutions. Over time, I-mode will migrate to, and merge with, WAP. As WAP and I-mode mature and evolve toward third-generation wireless systems, they will converge, drawing on and reusing the best features of both worlds. Ericsson and NTT DoCoMo recently held a workshop and presented an overview paper on this topic at a meeting of the WAP Forum in Sydney, Australia.

SIM-toolkit

The SIM-toolkit complements WAP. SIM card-based applications have the potential—in a very restricted way—to access information on the Internet using SMS. However, because the SIM card/SMS system lacks flexibility to switch applications, it cannot compete with WAP.

Most backers of the SIM-toolkit are subscriber identity module (SIM) card manufacturers and companies that work on security issues. All are committed WAP Forum members who have declared that the SIM-toolkit is solely a complementary technology that will be integrated into a GSM-specific version of WAP 2.0.

Rapid market penetration

The recent launch of several WAP portals and the release of WAP terminals are expected to give WAP rapid market penetration (Figures 4 and 5).

The predicted market penetration is based on Ericsson's estimates of mobile penetration, a three-year life expectancy for non-WAP phones, a two-year life expectancy for WAP phones, and percentages of WAP-enabled phones being sold per system.

Initially, not all users of WAP-enabled phones will have active WAP subscriptions. In 1999, only 20% of users with WAP-enabled phones had active WAP subscriptions; during 2000-2001, this number is expected to reach 30%. By 2004, nearly 95% of all users with WAP-enabled phones are expected to have active WAP subscriptions.

The percentage of WAP users who subscribe to WAP-based financial services is expected to equal that of users who use the Internet for similar services. The International Data Corporation (IDC) estimates that this number will increase from 23%, in 1999, to 36%, in 2004. Approximately 50% of all financial transactions via WAP are expected to be served by a WAP gateway owned by financial institutions.

Some 40% of all WAP users are expected to use their WAP phones at work. This is the percentage of corporate mobile phone subscriptions in Scandinavia. Nearly 15% of the WAP phones used at work will be served by enterprise-owned WAP gateways.

WAP evolves with the network

Evolving networks and technology

Present-day WAP services use two different bearer services: circuit-switched data (CSD) and short message service (SMS), each of which is significantly limited. Ericsson's network solution offers WAP over unstructured supplementary data (USSD), but at present there are no terminals that support this solution.

A CSD phone call can take up to 30 seconds to set up, which causes a major barrier for WAP. Even by improving the access

time for WAP services over CSD this delay is still an obstacle to using WAP services—when a fast-access server is used, the total delay can be reduced to only 8 or 10 seconds; when a proprietary non-authenticating access server solution is used the delay can be reduced to 5 seconds.

By contrast, the set-up time for WAP over SMS is extremely short, but since SMS has far lower bandwidth than CSD, WAP over SMS is slow for services that transmit large amounts of information to the mobile terminal.

The deployment of general packet radio service (GPRS) will eliminate delays—the access time will be insignificant since GPRS is always online. Furthermore, GPRS offers much greater bandwidth than CSD.

Bluetooth is another technology that will enhance and work in symbiosis with WAP. Bluetooth will greatly enhance mobility by opening the way for communication with other electronic devices; for example, in shops. When used in combination with WAP, Bluetooth will enable communication between end-users, electronic devices, and applications and storage in the network or the Internet.

Evolution of WAP

The WAP 1.2 specification was recently approved, which means that PUSH functions, wireless telephony applications, and end-to-end solutions (compliant with WAP 1.1) are now being launched throughout the world.

Future revisions of the specification will include functions for billing, smart cards, WAP over Bluetooth, WAP in third-generation wireless systems, multimedia, and convergence with XHTML. In short, we can characterize the evolution of WAP as:

- increasing the functionality of WAP in current second-generation wireless systems, thereby strengthening the systems in use today; and
- extending the abilities of WAP to work in conjunction with other technologies, now and in the future; for instance, paging, Bluetooth, smart cards, and so forth.

WAP will also develop into a major service of third-generation wireless networks.

Conclusion

Browser technologies for handheld devices are one of several key enablers for the mobile Internet. Of the competing browser technologies, WAP is almost certain to emerge as the dominant solution for second-generation systems. Over time, WAP will maintain its position and evolve to adopt the characteristics of third-generation wireless systems.

Certain key characteristics that have been observed in newly emerging business models are as follows:

- The role of mobile portals is more important to the mobile Internet than that of traditional portals to the Internet.
- Several new classes of service will accompany the rise of the mobile Internet.
- The mobile Internet vastly improves the potential of mobile electronic commerce.

As new business models take form, network operators are finding themselves in a key position to serve as mobile Internet payment and transaction centers, mobile Internet portals, and sites for mobile Internet-based e-commerce.

The deployment of WAP end-to-end solutions this year (2000) will be welcomed and give rise to rapid, large-scale market penetration. These services will evolve with the introduction of GPRS, Bluetooth, and third-generation wireless technology. Application developers who develop WAP services will later develop services for EPOC, GPRS, Bluetooth, Parlay, and third-generation systems. WAP is thus more than just another wireless technology; it is the catalyst of the mobile Internet. Within two to three years, WAP will have become a convenient commodity among mobile end-users, significantly changing the way they approach and carry out numerous daily tasks.

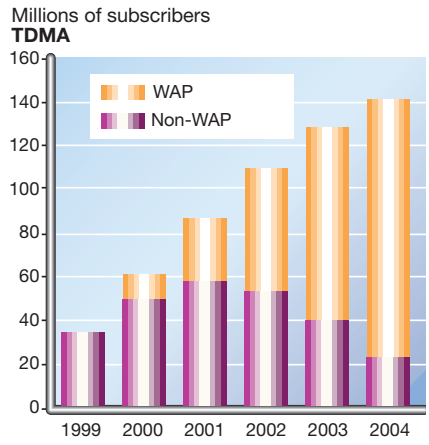


Figure 5
Estimates of WAP penetration into TDMA. Note: These estimations assume WAP interoperability, WML application development, and the availability of WAP-enabled phones.