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Business applications of WAP

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Contents

Introduction

1. **Outline**

'The Wireless Application Protocol (WAP) is the platform for media phones. It provides an open universal standard for bringing Internet content and advanced value added services to mobile phones and other wireless devices' (Nokia White Paper, 1999:3). Further definitions of WAP are discussed first. Because of the numerous references to other terms a glossary has been provided for further definitions (Appendix A), so as not to bog the article down with too many definitions.

WAP provides a uniform technology with consistent formats. This is provided through the various standards working together in the various layers, which are broken down and briefly explained. An example of how WAP and HTTP fits together is provided. The way the network fits together is described and an example of a wireless application ‘in action’ is shown using a calendar as an example.

The development of the Internet and mobile communications has been rapid, and the development of the wireless application protocol has been driven by this development. The background to the wireless application protocol includes the growth in the mobile industry and mobile data communications.

'The Wireless Application Protocol is an important development in the wireless industry because of its attempt to develop an open standard for wireless protocols, independent of vendor and air link' (GSM, 2000:Online [1]). This leads to a discussion as to why standards

in this global world are so important. Part of these standards is to have a body that produces them and integrates development, which is the service that the WAP Forum provides.

As with new technologies, WAP has the potential to have a huge impact on business tools, e-commerce and information services. The benefits of WAP impact almost everyone. There is a brief overview of the benefits to various parties. This is then broken down into the direct benefits to consumers and corporate users, especially from an information management point of view.

Because of the bandwidth restriction, small screens and limited keypads, there are design and development limitations when developing applications that make use of WAP which are discussed under the heading of disadvantages. The greatest impact that these disadvantages have will be on the applications for WAP, limiting the amount of information that can be sent and displayed. It seems to be key today to see problems as challenges and reducing the fat when it comes to data transmission can in fact be made an advantage for consumers of information, as they will receive the well thought out, pertinent nuggets that need their attention.

2. **Definitions**

'WAP: The de facto worldwide standard for providing Internet communications and advanced telephony services on digital mobile phones, pagers, personal digital assistants and other wireless terminals' (WAP Forum 2000, Online[1]).

Or, more basically put by GSM (2000, online [1]): 'WAP is simply a protocol – a standardised way that a mobile phone (and other mobile devices) talks to a server installed in the mobile phone network'. So, similarly to HTTP, WAP is a standardized protocol that has been developed for worldwide use, to enable collaboration and to provide standards.

For other relevant definitions please see Appendix A - the glossary.

top

How the wireless application protocol works

'WAP provides a uniform technology platform with consistent content formats for delivering Internet and Intranet based information and services to digital mobile phones an other wireless devices' (Nokia, 2000:Online [3]). WAP provides this uniform platform and consistent content formats through using standardised protocols, provided in the WAP protocol stack.

1. **The Protocol Stack**

WAP has a layered architecture as shown in the diagram below (GSM 2000:Online [2]):
Figure 1 WAP layers

Wireless Application Environment (WAE)
Wireless Session Protocol (WSP)
Wireless Transaction Protocol (WTP)
Wireless Transport Layer Security (WTLS)
Wireless Datagram Protocol (WDP)
Bearers e.g. Data, SMS, USSD

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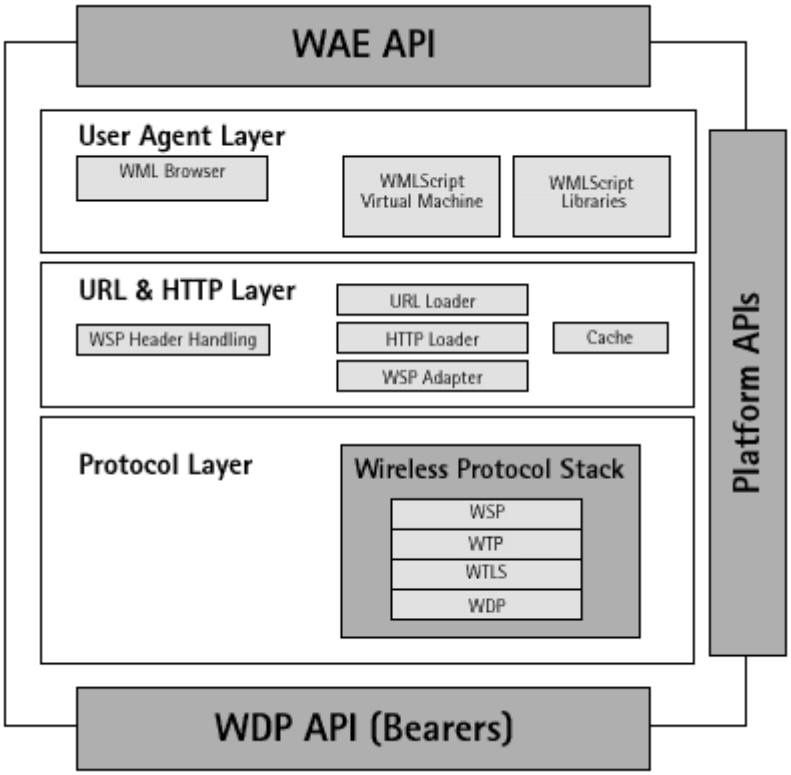
A protocol stack is 'a set of protocols that work together on different levels to enable network communication' (Microsoft 1998:CD – also see Appendix 1). The WAP protocol stack follows the ISO standard, where the higher levels of the stack deal with the application level interactions (the software), working down to the bottom layer that deals with the hardware. Definitions of each of the layers can be found in the glossary.

2. **WAP and HTTP**

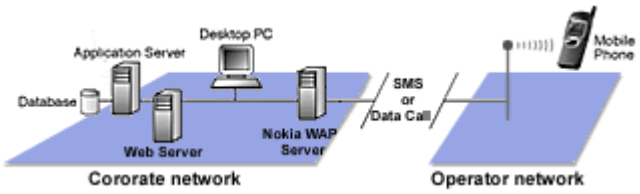
How does the WAP protocol stack fit in with HTTP to interface to the application environment? Following is a diagram of a Wireless Protocol Stack fitted into a client application (Nokia, 2000:Online [2]).
Figure 2 WAP client



The Wireless Application Environment, having been defined by developers, is the environment with which the user will interact directly. Interfacing to this is the User Agent Layer, providing the converted data that the application environment will display. WAP uses the HTTP and URL layer for pointing and for loading certain applications (i.e. retrieving the content that is in HTML format).

3. **The Network**

The following figure (Nokia, 2000:Online [2]) provides an example specific to a mobile cellular phone, but the concept can be applied to any other mobile devices with a link to a network:
Figure 3 The connection between networks

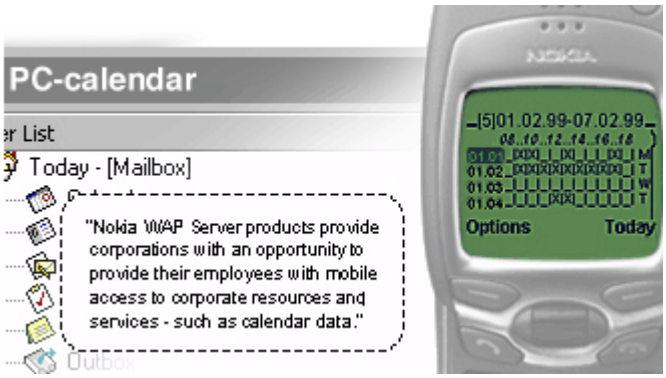


The Operator network accesses the WWW and corporate servers to optimise the data that will be transmitted through the wireless (operator) network. WAP can operate on all wireless networks available. The corporate network (or an Internet ISP) links to the operator's network (and therefore the mobile device) through a data call. The network will need access to a WAP server for the conversion of the data, as shown in the corporate network above.

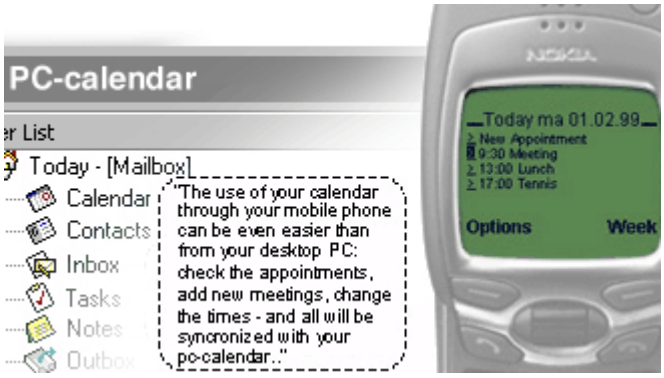
An Example

The following example has been taken from Nokia (2000, Online [1]).

As seen in the figure below a user can, through the corporate network, access their calendar on their cell phone, and see which blocks are marked as booked, indicating appointments:
Figure 4 Accessing information



Once a time has been established that suits both parties, a new appointment can be set up, which will be synchronized with the calendar at work, so that it will be updated for the next time it is accessed. As can be seen in these examples, although the screen is small, the writing is not illegible (although here somewhat obscured by the printed reproduction), and the ability to add data might be functional, but is considered adequate.
Figure 5 Adding information



top

Background to the wireless application protocol

'Since the early 1990s, the wireless world has been changing very rapidly, from analog to digital, from voice service to multimedia service, and from regional systems to global systems. This progress is due to recent developments of key wireless communication technologies as well as to rapidly increasing demand for wireless access to the Internet that has the same transmission quality as wired Internet systems' (Sampei, 1997:xv). This demand has brought together various groups, forming the WAP forum, for standardizing the Wireless Application Protocol.

Mobile communications have been keeping up with the demand for more and more services. According to Groves (1998:10) future mobile communications users might expect to see:

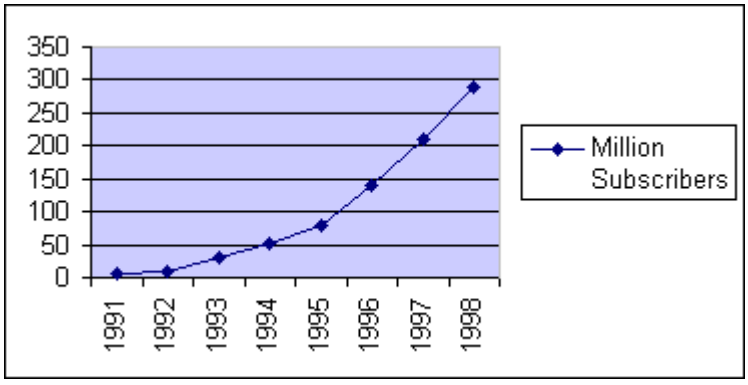
- broadband and multimedia capability;
- flexible bandwidth on-demand allocation;
- speech quality comparable to fixed networks;
- packet data capabilities;
- global availability and global roaming;
- terrestrial and satellite capability in one system family; and
- mass market and niche market products in one system

Since the book was written, most of this has already been implemented within the cellular systems, and is available on some cellular phones. The broadband capability is however still limited, and the speech quality is only comparable to fixed networks if used near a broadcasting point.

Mobile data use has been growing rapidly, according to the Nokia White Paper (1999:2):
1998 73% of European corporations were using some kind of mobile data solutions;
1999 91% of those who were not said they would within 1999
60% of mobile data users in the USA would rather use mobile data instead of computers.

The WAP rides on top of an extremely strong mobile phone market, as show in the figure below (Nokia White Paper, 1999:5).

Figure 6 World-wide mobile phone subscribers



The increasing use of mobile data communications, and the increasing use of mobile phones has led to the following dramatic headline: 'Wireless Internet to surpass PC Internet' (NUA, 02-2000:[Online]). According to this article, by 2003 61.5 million people will be using wireless devices. There are currently 7.4 million users in the US (drawn from a new report by IDC Research) giving a potential growth of 728%. IDC noted, '1999 saw two major advances in the mobile Internet market':

- Microsoft’s endorsement of the wireless application protocol; and

- the proliferation of portals built specifically for wireless devices.

top

Standardization

1. Importance of standardization

Heeralall (1992:21-28) recognized the importance of standardizing mobile/wireless communications, most of the principles of which still apply today, and has been summarized as follows:

- Networks must interconnect to provide a basic service.
- Users should be able to roam as widely as possible.
- Collaboration helps to prevent the restrictions that patents can put onto ideas being used; 'it is difficult to make patented ideas become standards'.
- In contrast to other industries, for example the car industry, users need to connect across networks globally and use competing services (this applies to users of the Internet as well).
- 'Globalisation … introduces an international spirit' and therefore needs a collaborative spirit (since this book was written the various cellular providers have shown this collaborative spirit and have standardized the wireless application protocol between them).

'Since WAP is an open protocol for wireless messaging, it provides the same technology to all vendors regardless of the network system. This means that there will be WAP compliant terminals from several manufactures. Also, the server technology is open, so operators and companies can select from a wide range of products' (Nokia, 2000:Online [3]). The Internet Age has increased collaboration, as can be seen from the formation of the W3C. This collaboration benefits everyone concerned, and with the need to be able to use services globally, it is not really in the best interests of providers to have unique products, working only with their system. The leading edge will be given to those providing value-added services that use standards, such as WAP. The recognition for the need to collaborate is the reason the WAP Forum was formed.

2. WAP Forum

'The WAP Forum is a non-profit industry association open to all industry. It has published a global wireless protocol specification based on existing Internet standards such as XML and IP for all wireless networks. Founders of the WAP effort: Nokia, Ericsson, Motorola and Unwired Planet chartered the Forum and opened it to general membership in January 1998' (Nokia, 2000:Online [3]). The WAP Forum's web site can be found at http://www.wapforum.org. The WAP Forum provides meetings for members to discuss developments and conferences to distribute and gather information.

'Today the WAP Forum represents over 90% of the global handset market, carriers with more than 100 million subscribers, leading infrastructure provides, software companies and other organizations providing solutions to the wireless industry' (Nokia White Paper, 1999:3). The WAP Forum has really managed to gather together all of the industry's big names into a collaborative effort, and with the kind of backing that it has, cannot fail to continue implementing the wireless application protocol and associated services.

- The goals of the WAP Forum for the wireless application protocol are as follows (WAP, 1999:Online):

- Independent of wireless network standard
- Open to all
- Will be proposed to the appropriate standards bodies
- Applications scale across transport options
- Applications scale across device types
- Extensible over time to new networks and transports.

3. **Partners in the WAP deployment**

Owing to the length of the list of full members of the WAP Forum, a list has been attached in Appendix B. Full membership fees are $27,500 USD per year, and an associate membership costs $7,500 USD per year. Full members may vote for directors and attend meetings, making it worthwhile for the ‘big names’ to sign up and be involved in the decision-making process.

top

Impact of WAP

'The trickle of companies promising products supporting the Wireless Application Protocol (WAP), … is becoming a flood' (IT Week, 1999 Online). Cell phone companies have been scrambling and producing cellular phones that have WAP-compliant micro browsers. Sagem (IT Week, 1999 Online) joined the race, and 'because the handset uses dual-band technology, it will allow free access to most mobile telecom networks across Europe'. It is not recommended for providers of mobile devices to allow WAP to bypass them, as they could well suddenly start losing clients as they turn to those who do provide the services. However, with 90 per cent of the global handset carriers participating in the WAP Forum, most companies have already recognized this.

1. **Effect of WAP on business tools**

Business tools will need to be adapted to be able to make use of the benefits of WAP. These benefits and examples thereof are provided in the next section. There is unlimited potential for corporations as they offer new services and products to their clients making use of this new mobile channel. According to the Nokia White Paper (1999:2), 'today people must carry with them at least a wallet, a calendar and a phone. Soon it will be only a phone – a media phone, which enables you to make calls, pay bills, buy tickets, check e-mail and manage your agenda.'

2. **Effect of WAP on e-commerce**

Because WAP is straightforward, existing applications can be easily adapted to the mobile environment. 'As of now, the mobile web means business' (Nokia White Paper, 1999:3). Those providers of e-Commerce that have not adapted need to climb onto the bandwagon as soon as possible. They should make the application changes needed and offer the changes to their users, so as not to be ignored by the users of mobile devices, who will turn to those who provide the service.

3. **Effect of WAP on information services**

Information delivery can be quicker, made more convenient to users and corporations and available to more people, as there are many more users of mobile phones in South Africa than there are users who have access to the Internet. For example, in some rural areas mobile access is available even where there is no landline infrastructure (and definitely no access to

computers).

Nokia, 2000:Online [3] provides some examples of how information services can provide immediate access through wireless access:

- Wireless access to Internet content, therefore providing immediate access to the information they need;
- access to corporate IT-systems and extranets;
- corporations can offer their services and also create totally new services for their mobile customers;
- wireless access to personal information, e.g. e-mail; calendars; to do lists; screen text headers for their voice mail messages; and
- intelligent telephony services: through access to their personal and other customer-related services

Information Managers should already be looking at their current systems, ensuring that the information content will be available to their users. Although the information technology side is not necessarily actually put in place by information managers, they need to get hold of their information technology departments now and start to drive the process. This is not a small project, and although some systems might need a few changes made to them, others will need quite a lot of re-thinking. This is mostly due to the small display, bandwidth limitations and limited keyboard functions, meaning that access to information content will need to be simplified. This is particularly pertinent in industries that provide a service.

top

Benefits of applications of WAP

Mobile phones, although the focus of this article, are not the only devices available. Pagers, smart phones and personal hand-held devices can also be used.

The benefits of WAP carry across most industries and people within industries. The telecommunications industry avoids overlapping costs and investments thanks to the common, open platform and tool for wireless messaging. As outlined by the WAP Forum (2000:Online):

- Carriers will be able to decrease risks and costs with revenue being increased.
- End users will benefit through easy, secure access to the information they require (via Internet and intranets) through mobile phones, pages, or other mobile devices.
- Manufacturers can access global open standards that already have critical mass. There are new product, marketing and revenue companies.
- Content Providers have access to previously untapped markets of mobile customers.
- Tool manufactures can add extensions to existing tools by taking advantage of the wireless marketplace.
- For developers, 80 per cent of the industry is behind it. This provides the necessary technology to develop, deploy and support wireless applications. 'There will be > 100 million compatible devices shipped worldwide by end 2000, which will result in significant revenue for developers' (WAP, 2000, Online).

What is also really interesting, besides the added business benefits, is how WAP can directly impact on consumers and to the corporate access to, and use of information.

1. **Consumers**

Some examples of consumers being able to reduce the 'hassle related to routine activities' have been summarised from the Nokia White Paper, (1999:5-6) and GSM (2000:Online, [4]):

- Banking, for example, checking the bank account balance and carrying out transactions
- Mobile phone alert for a threshold, for example when a stock limit has been reached
- On-line tickets, for example, changing a flight
- 'Infotainment', for example, the weather, sports, traffic information, yellow pages
- Define a shopping lists and receiving updated delivery times or triggering the delivery
- Voice and fax mail notifications
- Access to Internet email.

2. **Corporate Users**

Corporate users can implement the following uses (taken from the Nokia White Paper, 1999:6-7; GSM , 2000:Online):

- Sales force and field service automation. This can allow for contact management, ordering and deal tracking. Push notifications can distribute critical data when needed.
- Operations and maintenance. Equipping components with 'GSM chips', providing access to information about performance and the need for maintenance.
- Management information. There is a vast amount of information available with managerial value (e.g. in databases, enterprise applications and systems) which is often textual (requiring a low bandwidth) and which can be sent via WAP.
- Mobile access allows for real time operations, allowing for faster and better decisions (and therefore superior business performance).
- Job dispatches.
- Remote point of sale.
- Remote monitoring such as meter reading.
- File transfers.
- Document sharing/Collaborative working.

3. **To the future**

'Voice will remain an important application in the wireless world for the coming years. This is demonstrated by the success of already existing applications, such as phone banking. WAP is an application protocol for devices inherently geared towards voice communication and it accommodates the integration between voice and data applications' (Nokia White Paper, 1999:7). For longer transactions, voice will remain popular especially while the key functions are limited, however for a quick transaction, like retrieving a balance, which can be ‘wired’ to a specific key, the wireless transaction should become more popular.

'Market feedback will heavily influence future development' (Nokia, 2000:Online [3]). As users become used to the technology they will come up with their own ‘wish lists’ of what could be available and how it could be applied. An example of this, will be using hot-keying, so that only one button needs to be pressed to access a certain portion of information, or the calendar.

According to news.com, there are already possible alternatives to the Wireless Net. The article states that : 'An ordinary telephone will soon be the only device needed to access the Internet, according to a report from Cnet. A number of start-up companies are developing speaking Internet services that can be accessed from any telephone. These services will read e-mails, share prices, news and sports headlines and point-to-point driving instructions to

users.' Providers of these phones are hoping that they will compete with the wireless services as they will be perceived as more user friendly. The commands will be driven by voice, and not by the keypad. This service is only intended for those who will need access to the Internet for a brief period. This service will however have difficulty competing with the wireless Web when it comes to applications such as calendars, e-mail and e-commerce.

4. **Disadvantages of WAP/mobile devices**

Disadvantages or problems, such as the limited bandwidth and the specifics of a smaller user interface, have been seen as challenges to which WAP developers have risen.

1. Design limitations of using mobile devices

   Saving bandwidth is often mentioned as a limitation. According to the Nokia White Paper (1999:7), the coming broadband networks will offer increased bandwidth, initially limited to the metropolitan areas. This constraint must be kept in consideration.

   The devices will have limited displays and interfaces (Nokia; WAP). Owing to the use of mobile phones typically with one had, Internet browsing will be limited (Nokia White Paper, 1999:7).

2. Development issues

   Push not supported:
   According to GSM (2000:Online [3]), a push operation is not specified for the HTTP protocol, which is used by the WAP gateway server. The server will need to have the application interface to allow for the push generations and, on the client side, the capabilities of the mobile device will need to support this.
   Lack of cookies for session management:

   'Cookies are used on fixed Internet to identify the web browser and thereby assist in providing customised and streamlined services' (GSM, 2000:Online [3]). The protocol supports cookies (because it is based on HTTP) but the support will need to be built on the client side. In the mean time, some WAP applications use indexes in the URL as an alternative.

3. Impact of limitations on the benefits

   'The report finds that the biggest obstacle to the uptake of wireless Internet is lack of information on behalf of the consumer. Where the consumer tends to think that mobile Internet access involves downloading Web pages onto a cell phone, the reality is that the service will comprise of specialised newsfeeds, customised announcements and email capability via WAP all available on mobile devices' (NUA, 2-2000: [Online]).

   All applications designed with WAP must take the limited bandwidth into consideration, limiting the data that can be sent. This could be turned into an advantage in that only essential data could be sent out, limiting the amount of information that goes out and eliminating information that is not really needed. The Wireless Markup Language (WML) will speed up access to information, aiding with the smaller displays and interfaces.

top

Conclusion

'Who needs a PC? More than 90 percent of mobile phone manufactures have already committed to the new Wireless Application Protocol (WAP) specification … Starting next year, you'll be able to check your bank account, read headlines, and handle e-mail with your phone' (PC Computing, 1999:Online). It sounds good, however the providers of the data also need to buy into WAP and provide their services in a WAP friendly format.

'On the web, the conventional wisdom is that if you require more than three clicks to reach information, you will lose users' (Developer.com, 1999:Online). One way that sites have worked around this is providing large amounts of text on one page, this cannot be done when using a mobile device. Developer.com continues to say that 'the key to successful WAP design is simplicity: keep the information meaningful and brief'. This will force information providers to really sift through what they wish to provide, and to pull out the pertinent points.

This does mean that some development will need to be made for current sites, but the simplifying of information and Internet sites can benefit the end user. The key points that Developer.com (1999:Online) makes with regards to development for WAP are as follows:

- Keep your text concise
- Use images only when appropriate
- Keep the menu levels to a minimum
- Keep the information structured in a clear, logical fashion
- Use the standard layout techniques within WAP.

These could be applied to any good Web site (bar the last point) and the development of applications for WAP will however force these good development principles, providing simpler, more concise applications to end users.

Computer Chronicles (2000:TV) featured voice technology, detailed voice driven commands and recording devices for these commands. Users can give detailed instructions for setting up meetings, send e-mail and include attachments through these devices. However, imagine doing this through a mobile device that through wireless communication actually does all of this, as the voice commands are being given, while away from the office. This could be one way to overcome the limitations of having to use the keypad on a mobile phone. The future is limitless.

top

References

Computer chronicles. 28 February 2000. Voice technology. SABC 3, 23:00.

Developer.com. 1999. Design rules for mobile applications. [Online]. Available WWW: http://www.developer.com/journal/techworkshop/120399_mobile.html

Groves, I. 1998. Mobile systems. Great Britain: St Edmundsbury Press.

GSM. February 2000. An overview of wireless application protocol. [Online]. Available WWW: http://wwww.gsmworld.com/technology/wap.html [1]

GSM. February 2000. WAP protocol stack. [Online]. Available WWW: http://www.gsmworld.com/technology/wap_04.html [2]

GSM. February 2000. WAP development issues. [Online]. Available WWW: http://www.gsmworld.com/technology/wap_06.html [3]

GSM. February 2000. Applications. [Online]. Available WWW: http://www.gsmworld.com/technology/wap_11.html [4]

Heeralall, S. 1992. Why do we need standards for mobile/wireless communications? In: Nanda, S. & Goodman, D.J. Third generation wireless information networks. United States of America: Kluwer Academic Publishers: (21:28).

IT Week. March 1999. IT Week: Sagen joins WAP rush. [Online]. Available WWW: http://www.zdnet.co.uk/news.1999/12/ns-7535.html

Microsoft. 1998. Microsoft Press computer dictionary. CD.

News.com. 2000. Portals eye up alternative to wireless Net. [Online]. Available WWW: http://news.cnet.com/news/0-1004-200-1544891.html?dtn.head

Nokia. February 2000. WAP demo. [Online]. Available WWW: http://www.nokia.com/corporate/wap/future_demo.html [1]

Nokia. February 2000. Nokia WAP client. [Online]. Available WWW: http://www.nokia.com/corporate/wap/client.html [2]

Nokia. February 2000. WAP solutions for mobile business. [Online]. Available WWW: http://www.nokia.com/corporate/wap/future_wap.html and http://www.nokia.com/corporate/wap/future.html [3]

Nokia White Paper. 1999. WAP – the corporate perspective, version 1.0. [Online]. Available WWW: http://www.nokia.com/corporate/wap

NUA. February 2000. Wireless Internet to surpass PC Internet. [Online]. Available WWW: http://www.nua.ie.surveys

PC Computing. 1999. Business tools. [Online]. Available WWW: http://www.zdnet.co.za

Sampei, S. 1997. Applications of digital wireless technologies to global wireless communications. United States of America: Prentice Hall PTR.

WAP Forum. February 2000. Wireless application protocol – benefits. [Online]. Available WWW: http://www.wapforum.org/what/benefits.htm

WAP Forum, February 2000. Wireless application protocol forum (home page) [Online]. Available WWW: http://www.wapforum.org [1]

top

Appendix A - Glossary

Analog
adj. Pertaining to or being a device or signal having the property of continuously varying in strength or quantity, such as voltage or audio. Compare digital (definition 2) (Microsoft Dictionary, 1998:CD).

Application development environment
n. An integrated suite of programs for use by software developers. Typical components of application development environments include a compiler, file browsing system, debugger and text editor for use in creating programs (Microsoft Dictionary, 1998:CD).

Architecture
n. The design of application software incorporating protocols and the means for expansion and interfacing with other programs (Microsoft Dictionary, 1998:CD).

Backbone
n. 1. A network of communication transmission that carries major traffic between smaller networks. The backbones of the Internet, including communications carriers such as Sprint and MCI, can span thousands of miles using microwave relays and dedicated lines (Microsoft Dictionary, 1998:CD).

Cookie
n. 1. A block of data that a server returns to a client in response to a request from the client. 2. On the World-Wide Web, a block of data that a Web server stores on a client system. When a user returns to the same Web site, the browser sends a copy of the cookie back to the server. Cookies are used to identify users, to instruct the server to send a customized version of the requested Web page, to submit account information for the user, and for other administrative purposes. 3. Originally an allusion to 'fortune cookie,' a UNIX program that outputs a different message, or 'fortune,' each time it is used. On some systems, the cookie program is run during user logon (Microsoft Dictionary, 1998:CD).

Digital
adj. 1. Related to digits or the way they are represented. 2. In computing, analogous to binary because the computers familiar to most people process information coded as combinations of binary digits (bits). Compare analog (Microsoft Dictionary, 1998:CD).

e-Commerce (or electronic commerce)
n. Commercial activity that takes place by means of connected computers. Electronic commerce can occur between a user and a vendor through an online information service, the Internet, or a BBS, or between vendor and customer computers through electronic data interchange (EDI). Also called e-commerce (Microsoft Dictionary, 1998:CD).

HTML
n. Acronym for Hypertext Markup Language. The markup language used for documents on the World-Wide Web (Microsoft Dictionary, 1998:CD).

HTTP
n. Acronym for Hypertext Transfer Protocol. The client/server protocol used to access information on the World-Wide Web (Microsoft Dictionary, 1998:CD).

ISO/OSI model
n. Short for International Organization for Standardization Open Systems Interconnection model. A layered architecture (plan) that standardizes levels of service and types of interaction for computers exchanging information through a communications network. The ISO/OSI model separates computer-to-computer communications into seven layers, or levels, each building upon the standards contained in the levels below it. The lowest of the seven layers deals solely with hardware links; the highest deals with software interactions at the application-program level (Microsoft Dictionary, 1998:CD).

Protocol (or communications protocol)

n. A set of rules or standards designed to enable computers to connect with one another and to exchange information with as little error as possible. The protocol generally accepted for standardizing overall computer communications is a seven-layer set of hardware and software guidelines known as the OSI (Open Systems Interconnection) model. A somewhat different standard, widely used before the OSI model was developed, is IBM's SNA (Systems Network Architecture). The word protocol is often used, sometimes confusingly, in reference to a multitude of standards affecting different aspects of communication, such as file transfer (for example, XMODEM and ZMODEM), handshaking (for example, XON/XOFF), and network transmissions (for example, CSMA/CD) (Microsoft Dictionary, 1998:CD).

PROTOCOL stack
n. The set of protocols that work together on different levels to enable communication on a network. For example, TCP/IP, the protocol stack on the Internet, incorporates more than 100 standards including FTP, IP, SMTP, TCP, and Telnet. Also called protocol suite. See also ISO/OSI model (Microsoft Dictionary, 1998:CD).

URL
n. Acronym for Uniform Resource Locator. An address for a resource on the Internet. URLs are used by Web browsers to locate Internet resources. A URL specifies the protocol to be used in accessing the resource (such as http: for a World Wide Web page or ftp: for an FTP site), the name of the server on which the resource resides (such as //www.whitehouse.gov) and, optionally, the path to a resource (such as an HTML document or a file on that server) (Microsoft Dictionary, 1998:CD).

Wireless
adj. Of, pertaining to, or characteristic of communications that take place without the use of interconnecting wires or cables, such as by radio, microwave, or infrared (Microsoft Dictionary, 1998:CD).

Wireless markup language (WML)
n. A markup language that allows programmers to define the application’s user interface in a device independent way (Nokia White Paper, 1999:8).

WMLScript
n. A scripting language that allows programmers to embed executable logic in their applications (Nokia White Paper, 1999:8).

Wireless application environment (WAE)
n. The application environment consists of two things: a markup language (WML) and WMLScript. These allow the developer to define the application’s interface and then to embed logic in the applications (summarized from the Nokia White Paper, 1999:8).

Wireless application protocol (WAP)
n. The de facto worldwide standard for providing Internet communications and advanced telephony services on digital mobile phones, pagers, personal digital assistants and other wireless terminals (WAP Forum [1]).

Wireless datagram protocol (WDP)
n. Allows WAP to be bearer independent by adapting the transport layer of the underlying bearer. WDP presents a consistent data format to the higher layers of the WAP protocol stack thereby conferring the advantage of bearer independence to application developers (GSM, 2000:Online [2]).

Wireless session protocol (WSP)
n. A sandwich layer that links the WAE to two session services – one connection oriented operating above the Wireless Transaction Protocol and a connectionless service operating above the Wireless Datagram Protocol (GSM, 2000:Online [2]).

Wireless transaction protocol (WTP)
n. Part of the standard suite of TCP/IP protocols, used to provide a simplified protocol suitable for low bandwidth mobile stations. TWP offers three classes of transaction service: unreliable one way request, reliable one way request and reliable two way request respond. WTP supports Protocol Data Unit concatenation and delayed acknowledgement to help reduce the number of messages sent. This protocol therefore tries to optimise the user experience by providing the information that is needed when it is needed – it can be confusing to receive confirmation of delivery messages when you are expecting the information itself. By stringing several messages together, the end user may well be able to get a better feel more quickly for what information is being communicated (GSM, 2000:Online [2]).

Wireless transport layer security
n. WTLS incorporates security features that are based upon the established Transport Layer Security (TLS) protocol standard. This includes data integrity checks, privacy on the WAP Gateway to the client leg and authentication (GSM, 2000:Online [2]).

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