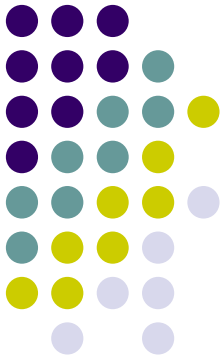
WAP

Bringing the internet to you



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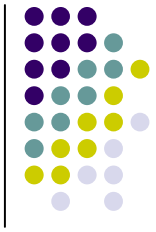


Summary

Wireless Application Protocol (WAP) is, in effect, a standard designed to allow wireless devices to access the internet and take advantage of their unique capabilities. With the recent release of WAP 2.0, and the large potential for WAP in today's market, there has never been a better time to examine this technology. The WAP architecture, specified by the WAP Forum, contains three major parts: the WAP protocol stack, the Wireless Application Environment (WAE), including the WAP Programming Model and markup languages for the wireless environment, and a host of extra features. Each of these is explained briefly, followed by an overview of current applications of WAP, and trends to be expected in the future.

Introduction

What is WAP?

WAP, or Wireless Application Protocol is a protocol designed to allow mobile devices to access the internet. Originally designed by Nokia, Ericsson, Motorola and Unwired Planet (previously Phone.com), the WAP protocol does not entail just a single protocol, but a whole suite of protocols[1]. Since mobile devices have far less computing power, transfer rates and memory than desktop computers, they can not simply use the standard internet protocols such as HTTP or TCP/IP. Instead, WAP was created to deal with the transformation of these internet protocols in an efficient manner to allow them to be displayed on a mobile device. Today, the founding members of WAP and a consortium of over 200 companies comprise what is called the WAP forum[2], which creates the standards used in WAP today[3].

WAP 2.0

The WAP 2.0 specification, released in January, 2002, differs from the original WAP specifications in a few ways. WAP 1.0 addressed basic interoperability, basic features, and established a certification program, while WAP 2.0 expands on this by providing support for Internet protocols like IP, TCP, TLS, and HTTP. WAP 2.0 also defines XHTMLMP and WML2, as well as an increased number of features. WAP continues to operate on all wireless technologies, including General Packet Radio Services (GPRS) and Third Generation (3G) cellular. WAP 2.0 also anticipates changing technologies, as well as the need to accommodate higher bandwidth and packet-based networks, higher-speed bearers, and newer devices.

Motivation for WAP

WAP was designed to accommodate constrained computing devices – devices which must deal with limited CPU capabilities, high latency, unpredictable availability and stability. WAP also allows enables users to take advantage of the added capabilities of these devices. Operators benefit because more efficient use is made of their network, and new services and applications can be added without changes in infrastructure or hardware. Content providers can increase their market, while customers will benefit from information services and new applications.

[1] See http://simplex.hemmet.chalmers.se/Jwap/doc/node9.html for more details.
[2] http://www.wapforum.org.
[3] See http://www.wapforum.org for more information on WAP and the WAP forum.

WAP Architecture

The WAP Protocol Stack

WAP is a suite of protocols. Conceptually, one can view the different protocols as being "stacked" on top of one another where each layer handles a different part of the data transmission. Figure 1 below shows the WAP protocol stack[4]:

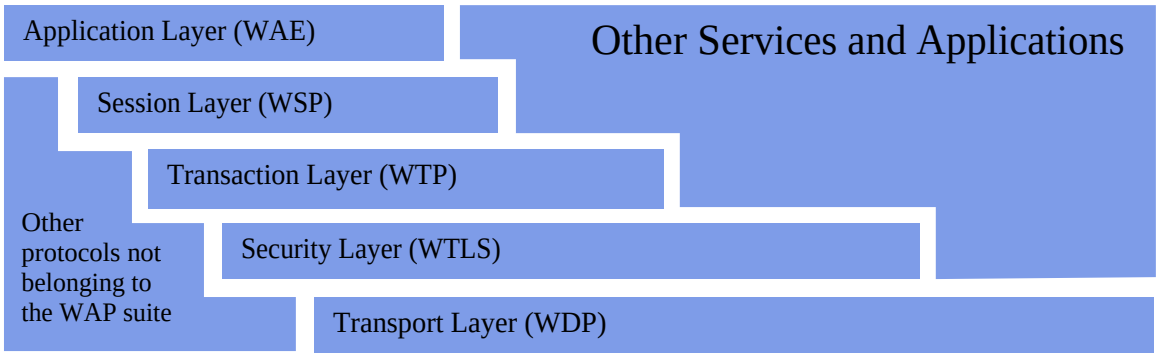


Figure 1: The WAP Protocol Stack.

The WDP (Wireless Datagram Protocol)

The bottom most layer of the protocol stack is the WDP. The responsibility of this stack is to provide a consistent data format to the higher levels of the protocol stack[5]. This allows the higher levels of the protocol stack to be bearer independent, a key asset for a mobile device. The WDP is modeled after the UDP protocol and is replaced by the UDP protocol when used over an IP network[6].

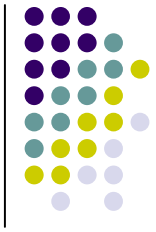
The WTLS (Wireless Transport Layer Security)

As the security layer of WAP, its responsibilities are to provide "privacy, data integrity, and authentication for applications to wireless terminals[7]." Though it is modeled after the SSL and TLS protocols, the Wireless Transport Layer Security has been optimized for mobile devices. The WTLS also provides mechanisms to encrypt or decrypt data. If an encrypted message needs to be sent, the WTLS compresses the message, encrypts it, and then sends it to the lower levels of the protocol stack to be transmitted. If an encrypted message is received, then this layer decrypts it before sending it to the upper layers[8].

The WTP (Wireless Transport Protocol)

Like TCP, the WTP is responsible for the sending of packets and the reconstruction of packets to and from the WAP Gateway or WAP Proxy. It also supports retransmission of packets as well as acknowledgements of messages[9]. In case of duplicate messaged, the WTP utilizes what is called a "transaction identifier" or "TID" in every message. The TID is used to identify packets

[4] Picture taken from http://simplex.hemmet.chalmers.se/Jwap/doc/node9.html..
[5] See http://www.handytel.com/technology/wap06.htm for more details.
[6] See http://www1.wapforum.org/member/developers/slides/wireless-protocols-group/sld015.htm.
[7] See http://www.mobileinfo.com/WAP/components.htm.
[8] See http://simplex.hemmet.chalmers.se/Jwap/doc/node36.html for more details.
[9] See http://simplex.hemmet.chalmers.se/Jwap/doc/node17.html for more details.



within a given transaction and is cached at the receiving end. If another packet arrives with a TID lower to or equal to a cached TID, then that packet may be a duplicate[10].

The WSP (Wireless Session Protocol)

Designed to implement a request – response protocol similar to HTTP, the WSP can support either a connectionless service or a connection – oriented service. A connectionless service does not remember the context between two messages whereas a connection oriented service does. A connection oriented service uses a single session for data communication while a connectionless service uses what is know as a "push" to send data back and forth[11]. A "push" is what occurs when the server sends data to the client without a previous request from the client. WSP also supports "session migration[12]" where the WAP client can suspend its session and resume it over a different bearer if necessary.

The WAE (Wireless Application Environment)

The WAE is a basic framework for WAP clients and servers. Created by the WAP Forum, the WAE sets the basics of what is required by WAP user agents (i.e. micro-browsers) and gateways[13]. It, however, does not specify how each micro-browser is to display the information (this is left up to the vendors of the user agents).

Designed to look like the World Wide Web (WWW), the WAE relies on URL and HTTP style semantics to display and request information. Languages such as WML (Wireless Markup Language), WMLScript (similar to Javascript), and WBXML (Wireless Binary XML) are all components of the Wireless Application Environment.

WAP Programming Model

The WAP Programming Model is an important part of the WAE. It aims to minimize the amount of data that must be sent over wireless networks, and the amount of processing required by user agents.

Basically, it is similar to the Pull Model of the Web Programming Model, but also enables a Push Model. The user sends requests to application servers, and the servers may send content in response to requests, or without a request.

With WAP 1.0, all communication between client and server occurred through a WAP proxy or gateway. Protocols optimized for the wireless environment could be used between the client and proxy, while standard Internet protocols could be used between the proxy and server. While a proxy may still be desired to take advantage of these optimizations, or to add service enhancements that might involve location, privacy, and presence-based services, with the advent of WAP 2.0, the proxy is only required to make use of the WAP Push capabilities.

[10] See http://simplex.hemmet.chalmers.se/Jwap/doc/node17.html for more details.
[11] See http://simplex.hemmet.chalmers.se/Jwap/doc/node15.html for more details.
[12] See http://simplex.hemmet.chalmers.se/Jwap/doc/node15.html for more details.
[13] See http://simplex.hemmet.chalmers.se/Jwap/doc/node10.html for more details.

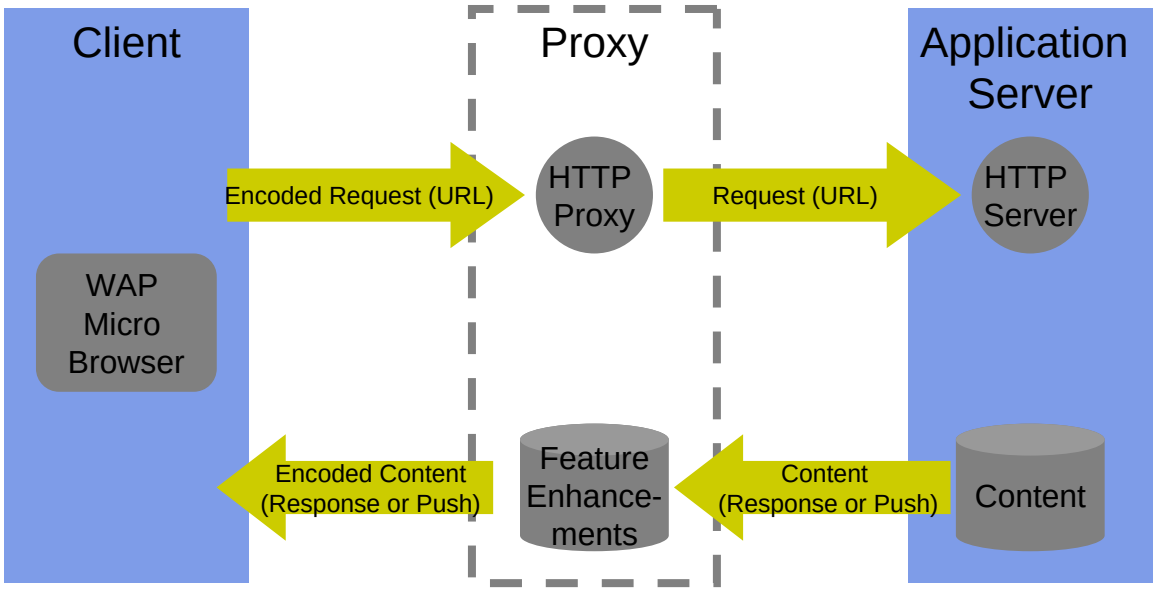


Figure 2: The WAP Programming Model. The WAP proxy or gateway, shown with a dotted line, is no longer required in WAP 2.0.

Wireless Application Environment Specifications

The WAE specifies many aspects that allow for the interaction between user agents with the WAP micro-browser, and WAP or Web applications. Some of these are described as follows.

Markup Languages[14]

The markup languages specified by WAP 2.0 include Extensible Hypertext Markup Language Mobile Profile (XHTMLMP) and Wireless Markup Language 2 (WML2). XHTMLMP is based on the XHTML Basic profile as defined by the W3C, and is intended to be the primary authoring language for WAP applications. WML2 is a superset of XHTMLMP, and includes extensions required for full, transparent, backwards compatibility with WML1 applications. A transformation model, using XSLT, permits documents to be converted from WML1 to WML2.

WAP Cascading Style Sheets

WAP 2.0 contains a specification for style sheets based on the mobile profile of CSS defined by the W3C. External and inline style sheets are both supported.

WMLScript

WMLScript is an ECMA script/ Javascript based client-side untyped scripting language that allows for additional control over content. Functions must be contained in separate files, but may be called from within WML decks or cards, and may be compiled before being sent to the user, in order to improve efficiency of transmission and client implementation. Also defined in WAP are many predefined core libraries for string and math manipulations, or functions specific to mobile users.

[14] These are not described in detail, as they are the focus of another report.

WBXML

Wireless Binary XML is the encoded form of content put out by the WAP proxy. This is basically a compact binary form of XML, where WML tags are replaced with one byte tokens and all comments are removed. A basic header, string table, attributes and end tags are also included. WMLScript is also compiled into a compact binary form.

Content Types

WAE specifies various content types, such as WBMP[15], and single bit-plane interchange format for black and white images, as well as vCard[16] and vCalendar for information and calendar items.

Figure 3: Image in JPEG and WBMP format.

```
BEGIN:VCARD
VERSION:2.1
N:Hans;Franzpopper
TEL;PREF:+49177123123
END:VCARD
```

Figure 4: Example vCard

Other Features

WAP Push

Content such as real-time messaging, notifications, traffic updates, or stock prices changes can be proactively sent to the user; the inefficient polling is eliminated. WAP also allows for control over the lifetime of messages, forwarding capabilities at the WAP proxy, and choice of bearers.

User Agent Profile (UAProf)

UAProfs allow client capabilities and user preferences to be communicated to a server. The application server may then modify content, or intermediate proxies may adapt content for the particular user. The specification for UAProfs is based on the W3C Composite Capabilities/ Preference Profiles (CC/ PP). User control over personal information sent in requests can be controlled.

Wireless Telephony Application (WTA)

WTAs allow telephone and internet services to be more integrated. The WTA specifications provide tools for handling phone services such as making and answering calls, editing phone books, placing calls on hold, or redirecting calls, through the use of WMLScript special functions or URLs. This framework also provides for WTA servers, which can interact with web, and voice networks, as well as other entities like voice mail systems. For example, a URL could tell a WTA server to access a voice mail system and allow a user to listen to their voice mail. At any given time, a WTA user-agent may have multiple WTA sessions (which use WSP sessions).

[15] Example from http://www.handytel.com/technology/wap01.htm.
[16] Example from http://62.146.2.89/www.wapterror.de/index.shtml.

External Functionality Interface (EFI)

Just as plug-ins extend browser functionalities, the EFI allows the WAE to interact with entities in applications that operate outside defined WAE capabilities. For example, the EFI could be used to define the interface required to access external devices like smart cards or digital cameras.

Persistent Storage Interface

WAP defines a standard set of storage services and an interface for organizing, storing, and retrieving data on wireless or otherwise connected memory devices.

Data Synchronization

WAP has adopted the SyncML language for data synchronization, and SyncML messages are supported over WSP and HTTP/1.1 protocols.

Multimedia Messaging Service

The MMS specifications of WAP allow delivery of multimedia, based on either a store-and-forward, quick delivery, or both models.

Provisioning

This defines a standard way for to provide clients with information needed to operate on wireless networks, and allows network administrators to manage devices.

Pictograms ☺

WAP provides for the use of tiny images in a consistent manner.

Applications of WAP

WAP is considered 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. This section of the document provides information about mobile devices, mobile data applications, and about the future of WAP.

Mobile data applications and content

The wireless Web is not only about news, sports and weather, but also about personalized Internet content and messaging. The available content and services for these mobile devices is still sparse. Today, owners of mobile phones and other handheld devices are able to access a small, but increasing range of web-based information and applications. Some of the current available content constitutes of pilot projects that provide related PC-browser Web sites, e-commerce applications and Internet banking services online. Local users can browse international sites, although their content may not be relevant to the local geographical area of the users. An example of an international site is Amazon.com which linked up with Nokia[17] to offer an m-commerce service to customers equipped

[17] Nokia is the world leader in mobile communications, and the leading supplier of mobile phones, and mobile, fixed and IP networks. More information is available on www.nokia.com

with WAP handsets, enabling them to set up their account, browse, search and shop by using their mobile phone. An increasing number of wireless service providers are hurrying to deliver dynamic, real-time, personalized Internet content to mobile users through a variety of mobile devices and smart phones with integrated Internet micro-browsers.

One of the Java applets that gives access to WML applications from a Web page is *Wapaka* for the web, a full WML micro-browser which is used by content providers, mobile portals and software developers to run WML applications just the way the application would be done on a mobile phone in real time. *Wapaka* also enables content providers to offer demos of their WAP services on their Web sites and to offer access to third-party WAP services like portals and search engines.

Many of the WAP-based mobile devices in the market today are developed by companies such as Nokia and Ericsson, including the following examples:

Nokia 6210 is a WAP phone with a built-in WAP browser that gives the mobile user 24-hours access to mobile Internet services like banking, booking tickets, checking news, and sending emails and faxes. This device uses HSCSD[18] to make browsing faster.

Nokia 7110 is an Internet WML micro-browser that supports WAP and GSM[19] data transmission with automatic error correction. It allows its mobile users to send and receive emails, faxes, and files. It also has a built-in infrared link to other devices such as PC, printers, and other Nokia 6100-series phones.

Nokia 9210 Communicator combines elements of third generation technology such as a high-resolution color display, high-speed mobile e-mail, professional PC applications, and multimedia capabilities, with its ability to access WAP services and sites saved as bookmarks.

[18] High Speed Circuit Switched Data.
[19] Global Services for Mobile Communications. See www.gsmworld.com

The Future of WAP

Today, the functionality level of mobile applications is still considered very basic. Mobile device users are starting to demand that the industry move from a fixed to a mobile environment, while still carrying the functionality of a fixed environment with it. The WAP Forum continues to develop a set of protocols that provide a common environment for the wireless market, an area notorious for the diversity of standards and protocols. Most of the world's key handset manufacturers are already involved in the WAP Forum and are announcing the impending release of WAP–compatible handsets. These handsets will contain a micro-browser that will serve to interpret the byte code generated from the WML content. The services available to users will be wide-ranging as the result of the open specifications of WAP and the simplicity of the WML language. Essentially, the WAP application strategy involves taking existing services that are common within a fixed-line environment and re-designing them to be user-friendly in a wireless environment.

The main issues faced by the wireless industry today concern the size of mobile phones, power supplies, display size, usability, processing power, and the role of PDAs[20] and other mobile terminals. As mobile commerce becomes a more secure channel by which consumers may conduct their financial affairs, the market for WAP will become even more lucrative. The competition for WAP comes from different sources such as SIM[21] toolkit, the use of SIMs, or smart cards in wireless devices. The SIM Toolkit provides the ability to manipulate the menu structure of the mobile terminal so that the phone becomes personalized to its user. Other sources of competition are the JavaPhone™ API by Sun Microsystems and the cellular phones that can download extra features over the Internet; thus, customers will no longer be required to buy a new phone to take advantage of improved features.

Despite the competition and challenges that WAP faces, however, it still maintains advantages over other services, including:

- It is an open, vendor independent standard.
- WAP is network – standard independent.
- The transport mechanism is optimized for wireless data bearers.
- Applications can be downloaded from the server, enabling fast service creation and introduction compared to embedded software

As a result, the number of WAP devices and services can be expected to continue to grow dramatically. WAP will play a vital role in shaping future communication and information technology, allowing people to interact and stay informed whenever they wish, wherever they are. In effect, WAP is bringing the internet to you.

[20] Personal digital assistants.
[21] Subscriber identity module.

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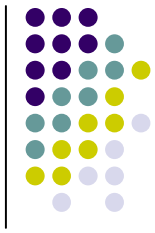

Glossary[22]

CDMA	code division multiple access
CDPD	cellular digital packet data
CSD	circuit-switched cellular data
CSS	cascading style sheets
DECT	digital European cordless communication
EFI	external functionality interface
GPRS	general packet radio services
GSM	global system for mobile communications
HSCSD	high speed circuit switched data
HTML	hypertext markup language
HTTP	hypertext transfer protocol
IP	internet protocol
JavaPhone	potential competitor for WAP
LAN	local-area network
MMS	multimedia messaging service
PCS	personal communications service
PDA	personal digital assistants
SIM	subscriber identity module; potential competitor for WAP
SMS	short message service
SyncML	language adopted by WAP for data synchronization
TCP	transmission control protocol
TDMA	time-division multiple access
TLS	transparent LAN service
UAProf	user agent profile
UDP	user datagram protocol
USSD	unstructured supplementary services data
W3C	world wide web consortium
WAE	wireless application environment; layer of WAP protocol stack
WAP	wireless application protocol
WAP CSS	WAP cascading style sheets
WAP Forum	organization that specifies WAP
WBXML	wireless binary XML
WDP	WAP datagram protocol; layer of WAP protocol stack
WML	wireless markup language
WMLScript	wireless markup language script
WSP	WAP session protocol; layer of WAP protocol stack
WTA	wireless telephony application
WTLS	wireless transport layer security; layer of WAP protocol stack
WTP	WAP transaction protocol; layer of WAP protocol stack
XHTML	extensible hypertext markup language
XHTMLMP	HTML mobile profile
XML	extensible markup language
XSLT	extensible style sheet language transformation

[22] Adapted from http://www.iec.org/online/tutorials/wap/.