Agilent Technologies

Protocol Evolution for the Mobile Internet

Application Note 1372

Agilent Technologies
Innovating the HP Way

Introduction

Most of the technology developed for the Internet has been designed for desktop and mobile computers that use medium to high bandwidth for communications. However, as the convergence trend continues, the telecommunications industry is now challenged with expanding Internet access to wireless devices such as handsets and personal digital assistants (PDAs), which differ greatly from computers in size, hardware, and display capabilities. Wireless Application Protocol (WAP), developed and deployed by Motorola, Nokia, Ericsson, and Phone.com in mid-1997, has emerged as one standard for delivering Internet content to mobile users. This paper reviews the capabilities and limitations of WAP and compares it to what may become the next-generation web/wireless protocol: Mobile Station Application Execution Environment (MExE).

An overview of WAP

Developed to combine the Internet and advanced data services in mobile applications, WAP specifies a framework and network protocols for wireless devices. Mobile devices equipped with a simple WAP Internet micro-browser enable wireless device users to access micro-browser-based services and applications that reside on the server instead of the mobile. As a result, Internet content and services are filtered for mobile communications, broadening the reach of the Internet to include users of mobile phones, pagers, two-way radios, PDAs, and other wireless devices. Server-based applications for mobile users are being created by using the WAP framework to develop applications on operating systems such as PalmOS, Windows CE, FLEXOS, OS/9, and JavaOS.[1] As figure 1 illustrates, WAP is designed to work with most wireless networks such as GSM, CDMA, CDPD, TDMA, iDEN, PDC, PHS, FLEX, ReFLEX, TETRA, DECT, DataTAC, and Mobitex.

How WAP links to the web

As figure 2 illustrates, mobile communication between Internet-based applications and services is a multi-step process. A phone equipped with a WAP micro-browser transmits requests in Wireless Markup Language (WML); a language derived from HTML especially for wireless network characteristics. The request is then passed to a WAP Proxy Gateway, which retrieves information from an Internet Web Server using WML. If the content being retrieved is in HTML format, a filter in the WAP Gateway may try to translate it into WML. The requested information is then sent from the WAP Proxy Gateway to the mobile device.

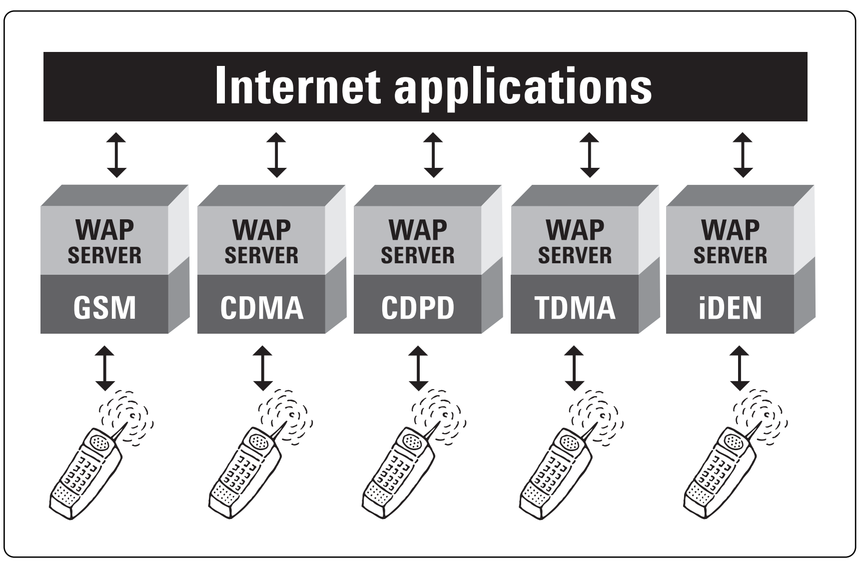

Figure 1. WAP for wireless network

1. WAP Forum, "Wireless Application Protocol: Wireless Application Environment Overview," November 4, 1999. http://www.wap.org

WAP architecture

Figure 3 illustrates that the WAP architecture is parallel to the existing Web/TCP/IP stack. Similar to the OSI and Internet models, the WAP architecture features a layered system architecture, where each architecture layer is accessible by the layers above, as well as by other services and applications.[2]

Wireless Application Environment (WAE)

When WAP is used, the Wireless Application Environment (WAE) defines the user interface on the mobile. It is based on a combination of web and mobile technologies. WAE supports multiple bearers by using a micro-browser environment that contain wireless markup language (WML), WMLScript, Wireless Telephony Application (WTA), and content formats. WML optimizes HTML for the hand-held mobiles. WMLScript is a scripting micro-language similar to JavaScript. WTA provides telephony services and programming features, while content formats are a set of defined data formats for items such as images and phone book information.

Wireless Session Protocol (WSP)

WSP provides the application layer of WAP with a consistent interface for two session services: one connection that operates above the Wireless Transaction Protocol (WTP) and another connectionless service that operates above the Wireless Datagram Protocol (WDP).

Wireless Transaction Protocol (WTP)

WTP runs on top of a datagram service such as User Datagram Protocol (UDP), which is part of the standard suite of TCP/IP protocols. WTP provides a simplified protocol suitable for low-bandwidth mobile stations and offers three classes of transaction service: 1) unreliable one-way request, 2) reliable one-way requests, and 3) reliable two-way request respond. WTP supports Protocol Data Unit (PDU) concatenation and delayed acknowledgement to help reduce the number of messages sent.

Wireless Transport Layer Security (WTLS)

WTLS is a security protocol based upon the industry-standard Transport Layer Security (TLS) protocol. WTLS incorporates security features that have been optimized for use over narrow-band communication channels. It provides features such as data integrity checks, privacy, authentication, and denial of service protection.

Wireless Datagram Protocol (WDP)

The transport layer protocol in the WAP architecture is referred to as WDP. This WAP layer allows operations under various wireless network types, which is accomplished by adapting the transport layer to specific features 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.

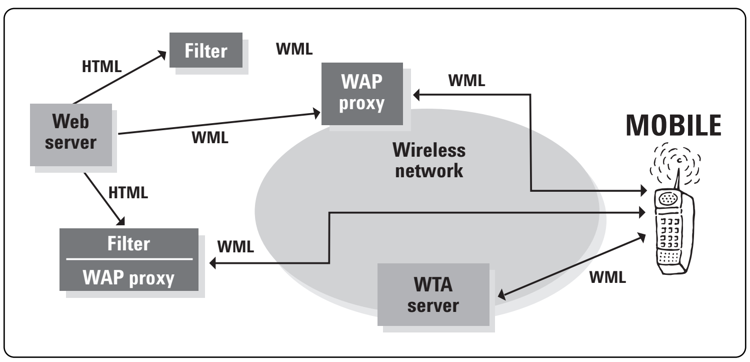

Figure 2. How WAP links to the Web

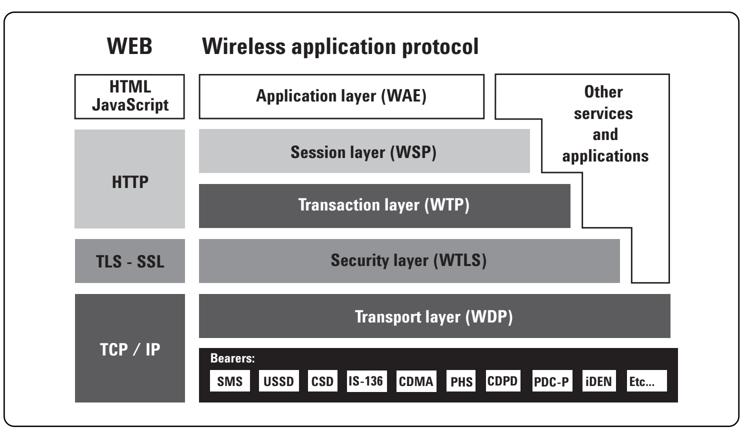

Figure 3. WAP architecture

2. WAP Forum, "Wireless Application Protocol: Architecture Specification," April 30, 1998. http://www.wap.org

Bearers

The WAP protocol is designed to operate over a variety of different bearer, including short message, circuit-switched data, and packet data. The bearers offer differing levels of service quality with respect to throughput, error rate, and delays. The WAP protocol is designed to compensate for, or tolerate, these varying levels of service.

Applications and developments

As with any technology, the key to its success is predicated on it offering something consumers value enough to buy. This "must have service" will likely come in the form of a wireless application. WAP is similar to Java, which simplifies the application development process. In the past, application developers wrote proprietary software within the same platform. By separating the bearer from the application, WAP facilitates easy migration of applications between networks and bearers. This reduces the cost of wireless application development and encourages software developers to produce corporate and consumer applications. Examples of corporate and consumer applications that are being enhanced and enabled with a WAP interface are shown in figure 4.

WAP limitations and technical issues

Though numerous applications have been created using WAP, the development of "the must have" services that will captivate a broader consumer base may actually be impaired by the protocol's limitations and technical issues.

Slow speed

Because WAP is intended to run on top of a variety of bearers that offer speeds from 9.6 to 14.4 KBPS, none of the existing bearers are optimized for WAP. For example, many WAP services are using the well-established short messaging service (SMS) channel to access Internet-based content at approximately 9.6 KBPS. The limited length of 160 characters per SMS makes its use within WAP slow and expensive when dialing and receiving a series of SMSs from a server. WAP also accommodates circuit switched data (CSD) that requires dial-up connections that can take up to 30 seconds to connect WAP to WAP Gateways. Irrespective of the bearer, customers using wireless devices to access the Internet are likely to find these data exchange rates are unsuitable for "surfing," especially when charges are assessed by the minute.

Technical design errors: extreme accommodation to existing networks

One of WAP's design goals has been to provide protocols that work with every segment of the wireless industry (mobile, PDAs, etcetera). However, rather than developing protocols that use the existing Internet architecture, WAP has created an entirely new set of protocols, analogous to, but incompatible with, the existing Internet architecture. Additionally, because WAP has been designed to support virtually all networks, including those that were not designed or intended to run Internet-centric application protocols, the complexity of the WAP specification has significantly and unnecessarily been increased.

Vulnerable security

In the paper, "Attacks Against the WAP Wireless Transport Layer Security (WTLS) Protocol," Saarinen describes in detail a number of security problems with WTLS.[3] For example, although the WAP WTLS protocol is closely modeled on the well-studied TLS protocol, WTLS is vulnerable to datagram truncation attacks, message forgery attack, and a key-search shortcut for some exportable keys.

Applications

- Home automation
- Customer service Web browsing
- Voice and fax mail notifications
- Remote monitoring such as meter reading
- Document sharing/collaborative working
- Simple person to person messaging
- File transfer
- Remote point-of-sale
- E-mail
- Remote LAN access
- Audio (MP3)
- Mobile commerce
- Mobile banking
- Still images (JPEG)

Figure 4. Corporate WAP applications

3. Saarinen, Markku-Juhani, "Attacks against the WAP WTLS Protocols," University of Jyvaskyla, http://www.jyu.fi/~mjos/wtls.pdf

Browsing problems

There is a general perception that WAP makes the entire Internet content accessible to mobile devices. However, in order for a WAP device to retrieve information from a web site, the site must have a WAP-enabled server programmed to deliver the web site content to the mobile. If a particular site is not WAP-enabled, it will probably not be available to mobile subscribers. Use of the WAP specification to access web content requires the use of WAP gateways operated by the Service Provider. This places a layer of control and authority between the creator and consumer of web site content, diminishing the potential for unrestricted and organic growth of the Internet.

Patented protocol

WAP is aggressively promoted by the WAP Forum as an open, license-free standard for wireless Internet access. However, WAP's viability as a standard is compromised by a number of software patent restrictions. These include patents held by certain members of the WAP Forum itself, most notably U.S. Patent #5,327,529, held by Geoworks, and U.S. Patent #5,809,415 held by Phone.com. Patent infringement claims have already been made by both organizations.

Next generation solutions

Despite the forthcoming of the launch of General Packet Radio Service (GPRS), which is projected to achieve 115 KBPS transmission rates and charge by the number of transferred packets, or data volume, some predict that WAP standards will likely give way to competing technology. One such technology is the mobile execution environment (MExE).

Development of the initial MExE protocols is carried out in SMG4, the European Telecoms Standards Institute (ETSI) and the Global System for Mobiles (GSM) standards setting body. Supporters of this work include Motorola, Nokia, Lucent Technologies, and Nortel.

Its aim is to provide a comprehensive and standardized environment on mobile phones for executing operator or service provider specific applications. MExE builds a Java Virtual Machine into mobile devices, providing a "write one, run system, and platform" programming language.[4] MExE is expected to support intelligent network services by providing sophisticated and intelligent customer menus, integrating mobile phone location services, and supporting a wide range of man-machine interfaces such as voice recognition, icons, and softkeys.[5] In addition to expanding the range of features supported by WAP, MExE offers better security and greater control of telephony features and that could pave the way for mobile voice-over-IP calling.[6] (Refer to figure 5.)

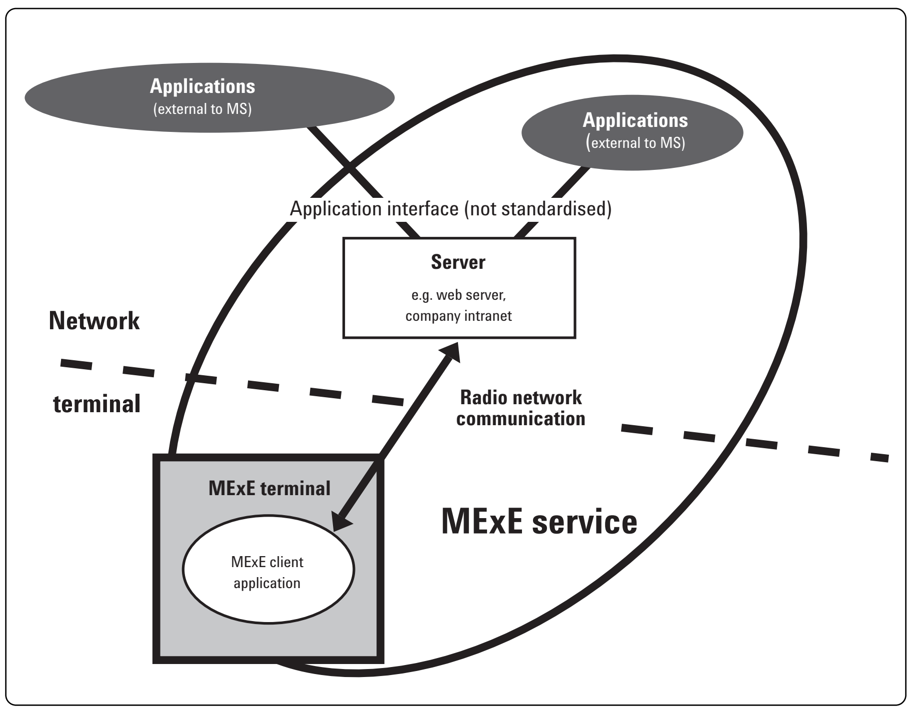

Figure 5. Mobile station application execution environment (MExE) service

4. ETSI, "Digital Cellular Telecommunications System (Phase 2): Mobile Station Application Execution Environment (MExE); Service description, Stage 1," GSM 02.57, Version 7.1.0 (1998).

5. TSG-T2 SWG1 Technical Document: Tdoc T3-99219 MexE. http://www.3gpp.org

6. Kramer, Richard and Simpson, Brett, "Wireless Equipment Technology-Goldman Sachs Investment Research report," *Goldman Sachs Investment*, November 10, 1999.

MExE shares several similarities with WAP. Both protocols work with a range of mobile network services. MExE terminal can include today's regular mobiles because MExE incorporates a capability indication method called classmarks. Classmarks define the MExE-related services that a particular terminal supports, enabling the MExE to identify the capabilities of mobile devices and communicate with WAP devices. However, because programming and running Java applications requires significant processing resources on the mobile client, MExE is primarily aimed at the next generation of powerful smart mobiles. Whereas WAP incorporates some scripting, graphics, animation, and text, MExE expands the capability to allow programming. This functionality necessitates that MExE includes a strict security framework to prevent unauthorized remote access of user's data.

Conclusion

While WAP has aided the convergence of wireless devices with the Internet, the truth growth of the "wireless web market" will not be realized without high-speed data rates and low consumer access fees. To achieve these market requirements, the present WAP/GSM environment is poised to give way to a faster WAP/GPRS network. This packet-based service environment will provide a taste of what can be done when high-speed services are combined with mobility. However, mobile processing will not be fully optimized without the deployment of wireless protocols, such as MExE, which offer JAVA-based technology for creating fuller mobile application programs.

Notes:

Related websites:

http://www.wap.org (WAP official website)
http://www.3gpp.org (3GPP website)
http://www.etsi.org (GSM/GPRS specifications)

For more information

Online:

www.agilent.com/find/wireless
for complete information about Agilent's solutions for the wireless industry.

Literature:

Wireless Communications Products, Literature number 5968-6174E (request from your local Agilent Technologies sales office)

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