



Wireless Application Protocol

WAP 2.0

Technical White Paper

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WAP 2.0 Technical White Paper

The WAP Forum is proud to release version 2.0 of the Wireless Application Protocol (WAP). WAP 2.0 brings the wireless world closer to the Internet with a suite of specifications that utilizes technologies that will enhance the wireless user experience. With this evolutionary release, the WAP specifications will continue as the de facto standard for wireless applications and services delivered across a wide range of devices.

WAP 2.0: Bringing Wireless Closer to the Internet

With the release of WAP 2.0, the WAP Forum has successfully accomplished several objectives:

- Add support for the standard Internet communication protocols. WAP 2.0 provides support for protocols such as IP, TCP and HTTP. By adding these Internet protocols and standards and providing interoperable optimizations suitable to the wireless telecommunications environment, the WAP specifications provide an environment that permits wireless devices to utilize existing Internet technologies.
- Continue the work of WAP 1.x by permitting applications and services to operate over all existing and foreseeable air interface technologies and their bearers: This includes the new, higher-speed technologies known as General Packet Radio Service (GPRS) and 3rd Generation (3G) cellular.
- Provide a rich application environment, which enables delivery of information and interactive services to digital mobile phones, pagers, personal digital assistants (PDAs) and other wireless devices.
- Address unique characteristics of wireless devices. These devices have hardware factors (e.g. smaller screens, limited battery life, and limited RAM and ROM) and user interface considerations, such as one-finger navigation, that challenge traditional Internet application design. The WAP environment provides many features that enhance this experience.
- Minimize the use of device processing power and optimize network resources in order to minimize costs and maximize performance.
- Incorporate flexibility, enabling a variety of user interface (UI) designs for manufacturers to differentiate themselves according to device form factor and target market requirements.

The WAP Forum works closely with organizations such as the World Wide Web Consortium (W3C) and the Internet Engineering Task Force (IETF) to develop specifications that meet the objectives listed above.

What Is New: WAP 2.0 is an Evolutionary Step Forward

The WAP Forum released its first specification – WAP 1.0 – in 1998. In subsequent WAP specification releases, the WAP Forum addressed interoperability, established a certification program, and added various features in response to changes in market requirements and improvements in networks, devices and new technologies.

WAP 2.0 is a next-generation set of specifications that, like previous releases, marks the WAP Forum's ongoing efforts to adopt the most recent Internet standards and protocols. WAP 2.0 also optimizes usage of higher bandwidths and packet-based connections of wireless networks worldwide. While utilizing and supporting enhancements in the capabilities of the latest wireless devices and Internet content technologies, WAP 2.0 also provides managed backwards compatibility to existing WAP content, applications and services that comply to previous WAP versions.

The following items represent the major architectural components of WAP 2.0:

- **Protocol Stack Support** – In addition to the WAP Stack introduced in WAP 1, WAP 2.0 adds support and services on a stack based on the common Internet stack including support for TCP, TLS and HTTP. By encompassing both stacks, WAP 2.0 provides a connectivity model on a broader range of networks and wireless bearers.
- **WAP Application Environment** – Nominally viewed as the 'WAP Browser', the WAP 2.0 Application Environment has evolved to embrace developing standards for Internet browser markup language. This has led to the definition of the XHTML Mobile Profile (XHTMLMP). XHTMLMP is based on the modularity framework of the eXtensible HyperText Markup Language (XHTML) developed by the W3C to replace and enhance the currently used HTML language common today. The use of Internet technologies is not new for WML, as WML1 is a fully conformant XML language in its own right.
- **Additional Services and Capabilities** – The WAP specifications have had items that were neither part of the 'WAP Stack' nor the 'WAP Browser' but helped to enrich the environment defined in the WAP specifications. With WAP 2.0, there is a considerable increase in the number of features available to developers, operators and users.

These will be discussed more fully later in the document.

Alignment with New Technologies and Standards

WAP protocols are largely based on Internet technologies. The motivation for developing WAP was to extend Internet technologies to wireless networks, bearers and devices. Just as earlier versions of WAP anticipated developments in image displays, public-key infrastructure (PKI) and end-to-end security, messaging, push technology, and a number of W3C and IETF standards, WAP 2.0 capitalizes on a wide range of new technologies and advanced capabilities, such as:

- **Networks and Network Bearers** – Carriers worldwide are upgrading their existing networks with higher-speed bearers such as General Packet Radio Service (GPRS) and High-Speed Circuit-Switched Data (HSCSD) and introducing higher bandwidths and speeds in third-generation (3G) wireless networks such as W-CDMA and CDMA2000 3XRTT. These higher capable network bearers permit new types of content (e.g., streaming media) and provide an 'always on' availability. These new aspects of the serving networks permit new operational activities.
- **TCP/IP as Transport Protocol** – Most new wireless network technologies provide IP packet support as a basic data transport protocol. WAP 2.0 leverages IETF work in the Performance Implications of Link Characteristics (PILC) Working Group to develop a mobile profile of TCP for wireless links. This profile is fully interoperable with the 'common' TCP that operates over the Internet today.
- **Processors** – Manufacturers continue to introduce smaller devices with faster and more power-efficient processors and dipoles that are higher-definition and in color. Additionally, more efficient packaging technology permits smaller integrated circuits and more sophistication in a given size of device. The net effect is that new wireless devices have more capabilities that can be leveraged to enhance the services delivered to the user.
- **Mobile-friendly Technologies** – With the growth in usage of mobile devices, there is an increased awareness of the needs specific to the mobile user. The WAP Forum has worked with the W3C and the IETF to help characterize the key issues that impact wireless usage of the web. Through that involvement, and from the interest of their own membership, the W3C has lately presided over advances in more mobile-friendly technologies, including:
 - The release in late 2000 of the recommendation for the Basic profile for the Extensible Hypertext Markup Language (XHTML). This Basic profile incorporates the core elements of the XHTML language, which provides a framework for expandability and enhancement.
 - Recent updates to the Composite Capabilities/Preference Profiles (CC/PP) framework for describing user preferences and device capabilities. CC/PP provides the technical basis for the UAPROF device profile function.
 - The release of the Cascading Style Sheets (CSS) Mobile Profile provides a subset of CSS version 2 that is targeted at devices such as smart phones, personal digital assistants (PDAs) etc.

WAP 2.0 Components: Application Support, Protocol Stack and More

This section provides a general view about the components that make up the WAP 2.0 release. For more detailed information and copies of the relevant specifications, the reader is encouraged to visit the WAP Forum website: www.wapforum.org.

Wireless Application Environment

The Wireless Application Environment (WAE) provides for interaction between WAP/Web applications and wireless devices containing a WAP microbrowser.

WAP 2.0 provides the foundation for such a microbrowser in its markup languages, namely the XHTML Mobile Profile markup language (XHTMLMP) for new content and WML to support legacy WAP V1 content. These markup languages provide the appropriate presentational services for wireless devices, while capitalizing on their unique advantages. The accompanying client-side scripting language, WMLScript, provides for additional intelligence and control over presentation. To improve the efficiency of transmission and client implementation for the handling of both WML and WMLScript, WAE supports tokenisation of WML1 and the compilation of WMLScript before the gateway sends the content to the device.

In addition to specifying the markup language, WAE provides for other content types, such as WBMP images, vCard and vCalendar.

The WAE in WAP 2.0 continues to support an application-centric approach by defining XHTML Mobile Profile and several other associated technologies and includes the following elements:

- The basic markup language for the WAE in WAP 2.0, namely XHTMLMP, extends the Basic profile of XHTML as defined by the W3C. This core was designed to be extensible and WAE takes advantage of this capability by defining additional markup features for enhanced functionality. By using the XHTML modularization approach, the XHTMLMP language is very extensible, permitting additional language elements to be added as needed. Additionally, documents written in the core XHTML Basic language will be completely operable on the XHTMLMP browser.
- The WAE in WAP 2.0 also enhances the presentation of content by supporting style sheets. Based on the Mobile profile of CSS from the W3C, WAP support covers both inline and external style sheets, which are commonly supported by most Internet browsers.

- Full backwards compatibility support for WML1 applications is provided in the WAE for WAP 2.0 through either native support for both languages (WML1 and XHTMLMP) or by a defined transformation operation of WML1 to WML version 2. The WML2 language is an extension of XHTMLMP that adds specific features of WML1 for backward compatibility. The transformation process provides for the conversions, such as names and attributes, from WML1 to XHTMLMP as well as the support for the WML1 specific features. The WAP 2.0 release provides a transformation model, using eXtensible Stylesheet Language Transformation (XSLT), that will permit documents defined in WML1 language to be converted to WML2 code which would then operate on a supporting browser. The special extensions in WML2 are intended only to support conversions of WML1 documents and not for general authoring use.

These changes will let devices accept both content written for other Internet clients in XHTML Basic and applications and content written specifically to take advantage of the WML extension features. Enabling backwards compatibility protects investments in WAP 1 content.

WAP Programming Model

The WAP Programming Model, closely aligned with the Web Programming Model, uses the Pull Model, (which is where the client requests content from the server). However, WAP also extends the Web architecture by adding telephony support with WTA and enabling a Push Model, where a server can proactively send content to the client.

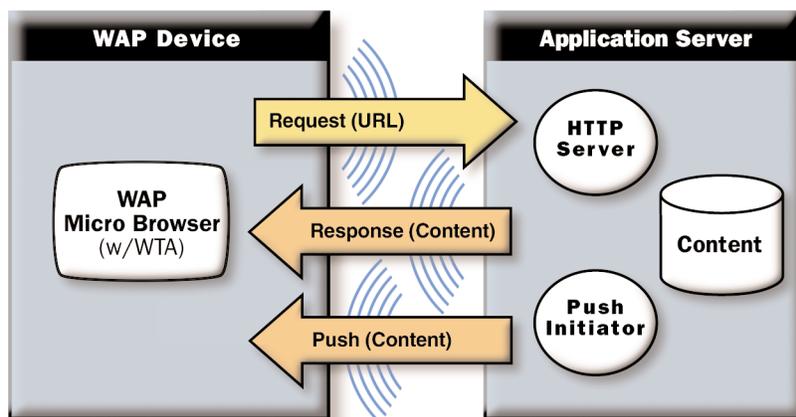


Figure 1: The WAP Programming Model

In previous versions of WAP, a WAP proxy (often referred to as a WAP gateway) was required to handle the protocol interworking between the client and the origin server. The WAP proxy communicated with the client using the WAP protocols that are based largely on Internet communication protocols, and it communicated with the origin server using the standard Internet protocols. WAP 2.0 does not require a WAP proxy, since the

communication between the client and the origin server can be conducted using HTTP/1.1. However, deploying a WAP proxy can optimize the communications process and may offer mobile service enhancements, such as location, privacy, and presence based services. In addition, a WAP proxy is necessary to offer Push functionality.

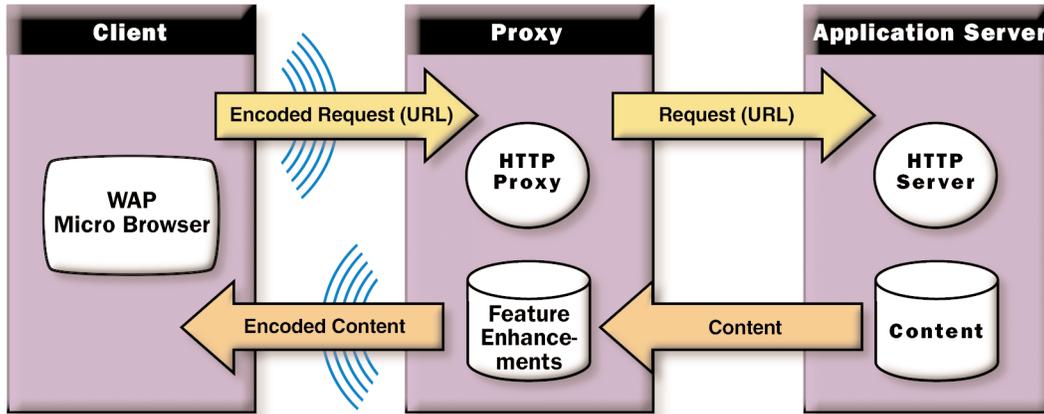


Figure 2: WAP's Optional Proxy Model Supports Network-Based Optimizations

WAP Protocol Stack

A key part of the WAP 2.0 release is the introduction of support for Internet protocols when IP connectivity is available to the mobile device. This is in addition to continued support for the legacy 'WAP Stack,' which is used over those networks that do not provide IP as well as low-bandwidth IP bearers. Both stacks are supported in WAP 2.0 and provide similar services to the application environment.

Legacy Protocol Layers

The WAP 2.0 release continues support for the 'WAP 1 Stack'. These protocols have been optimized for low-bandwidth bearer networks with relatively long latency.

- **Wireless Session Protocol (WSP)** – WSP provides HTTP/1.1 functionality and incorporates new features, such as long-lived sessions and session suspend/resume. WSP provides the upper-level application layer of WAP with a consistent interface for two session services. The first is a connection-mode service that operates above the transaction layer protocol, and the second is a connectionless service that operates above a secure or non-secure datagram transport service.

- **Wireless Transaction Protocol (WTP)** – WTP has been defined as a light weight transaction oriented protocol that is suitable for implementation in "thin" clients (mobile stations) and operates efficiently over wireless datagram networks. The benefits of using WTP include:
 - Improved reliability over datagram services. WTP relieves the upper layer from re-transmissions and acknowledgements that are necessary when datagram services are used.
 - Improved efficiency over connection oriented services. WTP has no explicit connection set up or tear down phases.
 - Advantage of using a message oriented protocol, designed for services oriented towards transactions, such as "browsing."

- **Wireless Transport Layer Security (WTLS)** – The WTLS layer is designed to provide privacy, data integrity and authentication between two communicating applications. It provides the upper-level layer of WAP with a secure transport service interface that preserves the transport service interface below it. In addition, WTLS provides an interface for managing (e.g., creating and terminating) secure connections. It provides a functionality similar to TLS 1.0 and incorporates additional features such as datagram support, optimized handshake and dynamic key refreshing.

- **Wireless Datagram Protocol (WDP)** – WDP is a general datagram service, offering a consistent service to the upper layer protocols and communicating transparently over one of the available underlying bearer services. This consistency is provided by a set of adaptations to specific features of these bearers. This thus provides a common interface to the upper layers that are then able to function independently of the services of the wireless network.

The following figure shows how this legacy stack operates between the WAP Devices and the WAP Gateway. In the figure, the WAP Gateway interconnects the services offered by WSP to the HTTP protocol to permit access to data on the wired Internet.

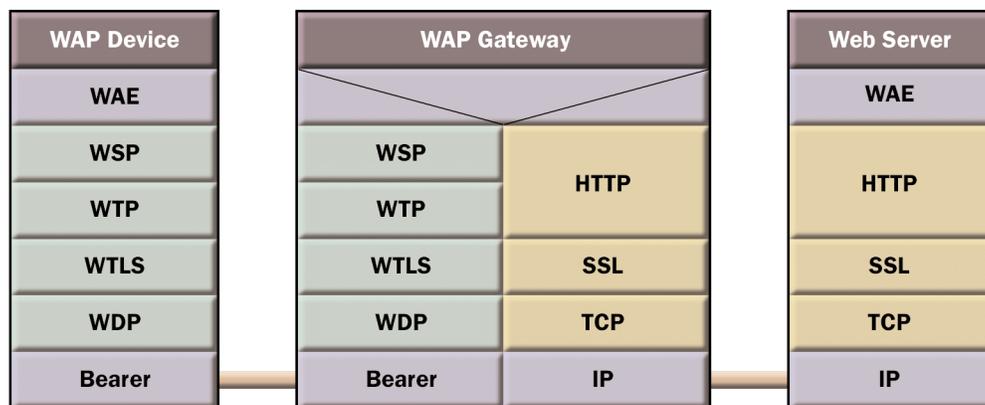


Figure 3: Example WAP 1 Gateway

Protocol Layers for Networks Supporting IP

A key feature of WAP 2.0 is the introduction of Internet protocols into the WAP environment. This support has been motivated by the emergence of high-speed wireless networks (e.g. 2.5G and 3G) that provide IP support directly to the wireless devices.

- **Wireless Profiled HTTP (WP-HTTP)** – WP-HTTP specification is a profile of HTTP for the wireless environment and is fully interoperable with HTTP/1.1. The basic model of interaction between the WAP Device and WAP Proxy/WAP Server is the HTTP request/response transaction. WP-HTTP supports message body compression of responses and the establishment of secure tunnels.
- **Transport Layer Security (TLS)** – A wireless profile of the TLS protocol will permit interoperability for secure transactions. This profile for TLS includes cipher suites, certificate formats, signing algorithms and the use of session resume. The profile also defines the method for TLS tunneling to support end-to-end security at the transport level.
- **Wireless Profiled TCP (WP-TCP)** – WP-TCP provides connection-oriented services. It is optimized for wireless environments and is fully interoperable with standard TCP implementations in the Internet. Research in optimizing TCP has resulted in a number of mechanisms to improve performance. This includes work by the IETF PILC group that has recommended the use of some of these mechanisms for TCP implementations in long thin networks. These have been documented in Standards Track RFCs and have been accepted by the Internet community as useful and technically stable.

The following figure shows an example usage of these protocols from the WAP Device to the Web Server. In this example, a TLS tunnel is enabled through an intervening WAP Proxy permitting secure, end-to-end HTTP transactions. The TCP* is a reference to end points that operate using the features of the wireless profiled TCP.

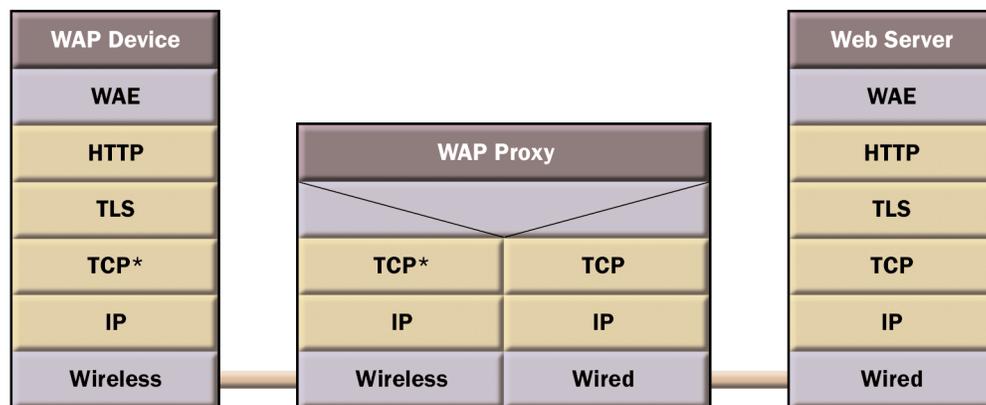


Figure 4: Example WAP HTTP Proxy with Profiled TCP and HTTP

Since WAP 2.0 provides support for both stacks, it should be noted that it is expected that these stacks would operate independently. That is, there would not be mixing and matching of protocols in accomplishing an end-to-end transaction. The following figure shows the separation of these stacks.

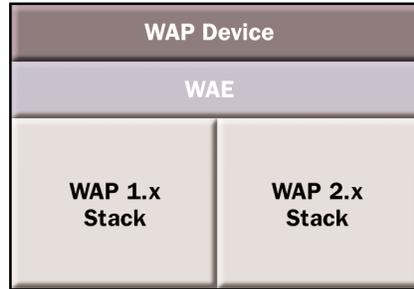


Figure 5: Optional Dual WAP Stack Support

The figure shows the expectation that a common application environment could operate over either stack. For devices that will be supporting both old and new network types, this switching of stacks may occur as the device moves in and out of coverage of the different network areas.

WAP 2.0 Adds New and Enhanced Services

In addition to the application environment and the increases in capability of the micro-browser, WAP 2.0 also supports other features to improve the user experience. These features expand the capabilities of the wireless devices and improve the ability to deliver useful applications and services. Some of these additional features of the WAP 2.0 release are:

- **WAP Push** – This service allows content to be sent or "pushed" to devices by server-based applications via a Push Proxy. This functionality has been enhanced for the WAP 2.0 release. Push functionality is especially relevant to real-time applications that send notifications to their users, such as messaging, stock price and traffic update alerts. Without push functionality, these types of applications would require the devices to poll application servers for new information or status. In wireless environments such polling activities would constitute inefficient and wasteful use of the resources of wireless networks. WAP's Push functionality provides control over the lifetime of pushed messages, store & forward capabilities at the Push Proxy and control over bearer choice for delivery.
- **User Agent Profile (UAProf)** – This service provides a mechanism for describing the capabilities of clients and the preferences of users to an application server. Enhanced for WAP 2.0 release, it is based on the Composite Capabilities / Preference Profiles (CC/PP) work of the W3C, UAProf supports the client-server transaction model by sending client and user information to servers with the request. This information permits the servers to adapt their content accordingly in preparation for the response. This service model would also permit intervening proxies to provide value-added services by providing these adaptation services directly. Recognizing the importance of user's privacy, personal information submitted in these requests may be controlled by the user.
- **Wireless Telephony Application (WTA)** – This service provides tools that provide for a range of advanced telephony applications to be operated from within the application environment that traditionally supports data functionality. These call handling services, such as making calls, answering them, placing them on hold and redirecting them, can be seamlessly combined with other data services. This truly permits WAP WTA enabled cell phones to be viewed as fully integrated Internet and voice service platforms.
- **External Functionality Interface (EFI)** – This service specifies the interface between WAE and components or entities with embedded applications that execute outside of the defined WAE capabilities. This is analogous to providing a plug-in module, which extends or enhances the capabilities of browsers or other applications. The EFI framework provides for future growth and extendibility of supported WAP devices. This framework can be used to define the specific interfaces needed for accessing external devices (e.g. smart cards, GPS devices, health care devices and digital cameras).

- **Persistent Storage Interface** – This capability specifies a standard set of storage services that are coupled with a well-defined interface for organizing, accessing, storing and retrieving data on the wireless device or other connected memory device.
- **Data Synchronization** – In an approach that helps to ensure a common solution framework, the WAP Forum sought out a solution for data synchronization. As a result, WAP 2.0 acknowledges the work of the SyncML initiative by adopting the SyncML language as its choice for the data synchronization solution. The SyncML messages are supported over both the WSP and HTTP/1.1 protocols. See www.syncml.org for more information.
- **Multimedia Messaging Service (MMS)** – This service provides the framework to implement a feature-rich messaging solution. MMS provides features and functionality that permits delivery of varied types of content. Depending on the service model, MMS permits a quick delivery paradigm (like SMS) or a store-and-forward approach (like email) or could permit both modes to operate. This flexibility permits users and operators to tailor the resulting user experience. By using other WAP services, like Push and UAProf, MMS provides an efficient messaging solution that is capable of providing message notifications which initiate adaptation services to structure the delivered content into a form that is efficiently used by the receiving device.
- **Provisioning** – This service provides a standard approach to providing WAP clients with information needed to operate on the wireless networks. This permits the network operator to manage the devices on its network using a common set of tools.
- **Pictogram** – This service permits the use of tiny images, such as this smiling sun , in a consistent fashion. Such images can be used to quickly convey concepts that permit efficient communication in a small amount of space. Such communication can transcend traditional language boundaries.

WAP: Evolving with Technology and Market Trends

The WAP specification evolves continually, and WAP 2.0 is a natural development based on the previous versions. It reflects adoption of the latest standards and protocols, accommodates change in the wireless environment, such as increases in bandwidth, data speeds, processing power, screen sizes, and other technologies, and anticipates market requirements. WAP 2.0 allows the Wireless Application Protocol to further integrate with the Internet. It enables deployment of advanced functions and services, while leveraging and extending benefits of previous versions of WAP via managed backwards compatibility.

WAP provides a long-term, durable platform for developers to build compelling content and applications for consumers and enterprises alike. It means increased sales opportunities for device and infrastructure manufacturers and delivers new revenue opportunities for service providers.

To download the WAP 2.0 specifications and further documentation (including more detailed description on the WAP 2.0 Architecture), please visit: <http://www.wapforum.org>.

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