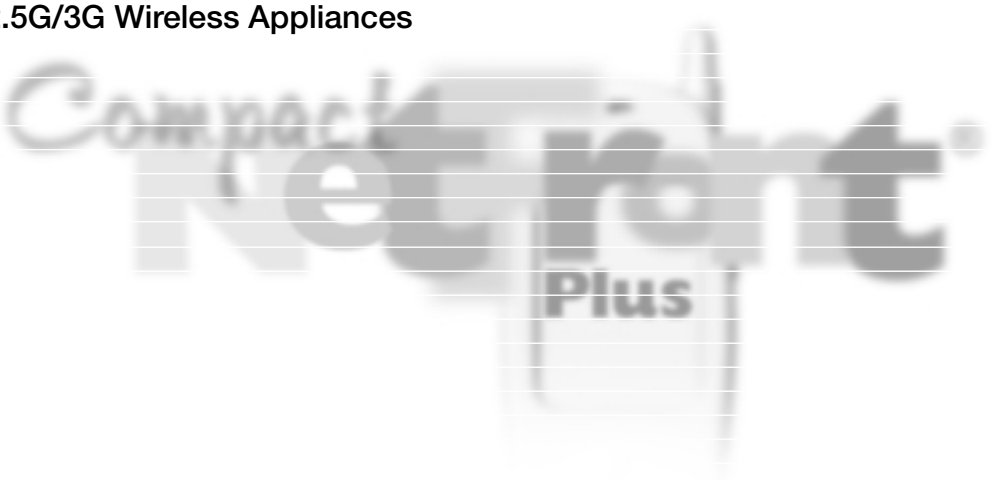
Compact NetFront™ Plus

The Micro-Browser for 2.5G/3G Wireless Appliances



ACCESS™

1. Introduction

As we enter the 21st century and the dawn of the post-PC era, it has become clear that the mobile phone and the micro-browser stand as the most powerful and efficient enabling technologies for **accessing the Internet anytime and anywhere.**

The wireless networking infrastructure is rapidly building toward high-speed Internet access services for wireless devices. Now is the time to apply open-standard Internet technologies to this evolving infrastructure.

One example of a mobile phone/micro-browser based Internet access service already using open-standard Internet technologies is NTT DoCoMo's wildly successful **i-mode** service. Since its launch in Japan in February 1999, more than 20 million subscribers have signed up for i-mode service, creating a phenomena that can best be described as the wireless Internet revolution. This revolution has in turn served as a catalyst for a new communication lifestyle and new industries including content services, B2B services and a new wireless Internet community. And ACCESS was there from the start, providing the most popular micro-browser for the i-mode service, **Compact NetFront**.

Based on the expertise and experience gained as the principal browser supplier for the i-mode service, ACCESS has now developed **Compact NetFront Plus**, a totally new micro-browser designed for next-generation, high-speed wireless services commonly known as 2.5G and 3G (Figure 1). Compact NetFront Plus supports the three most important language standards for mobile phones; Compact HTML [1] (used by the i-mode service), WML [2] (used by WAP services) and XHTML Basic [3] (regarded as the new global standard). Compact NetFront Plus uses http [4] and Wireless TCP/IP [5] on top of the physical underlying bearer network layer such as GSM/GPRS, CDMA, W-CDMA, etc. Java and other extension features can be plugged into Compact NetFront Plus.

This paper describes the concept, design principles, and software architecture of Compact NetFront. It also describes how to integrate the Compact NetFront Plus solution with current WAP services. And finally, it describes our vision for the future of the wireless Internet.

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Ver. 1.01/2001-04-26

Figure 1.
Compact NetFront Plus,
a new browser designed for 2.5G and 3G

2. A Brief History of ACCESS' Micro Browser

2.1 Compact HTML

ACCESS' strategy for developing wireless Internet technology solutions is simple and realistic—work within Internet standards as much as possible. ACCESS realized early on that the key to leveraging the tremendous resources that already exist on the Internet was to work within the existing standards. However, unlike the PC-based Internet, the wireless Internet faced handset hardware and wireless networking constraints and limitations, so ACCESS designed "Compact HTML" [1, 6], a subset of HTML, for small information appliances. In 1998, ACCESS together with NEC, Panasonic, Mitsubishi Electric, Fujitsu and SONY, submitted Compact HTML to the W3C (World Wide Web Consortium).

Compact HTML was designed from the start to take into consideration the limitations inherent within small mobile devices:

- Small display space
- Small memory capacity
- Low-power CPU
- Simple and easy button operation
- Narrow bandwidth and low-speed networks

The i-mode service is based on Compact HTML, and one of the reasons for its great success is the ease with which content can be developed. There are currently more than 40,000 Compact HTML web sites in Japan (March 2001), and the number of sites is rapidly increasing.

Another advantage of Compact HTML is that many devices with small displays, besides mobile phones, can also access content developed in Compact HTML. NTT (the largest fixed telephone operator in Japan) has announced an "i-mode"-like service called "L-mode", based on Compact HTML. Legacy home telephones and fax machines with micro browsers will appear in the market in 2001 and mobile game machines with modem functions are also accessing the Internet and relying on Compact HTML content.

2.2 Compact NetFront

Because PC browser software like MS Internet Explorer® and Netscape Navigator® require about 10MB of memory to operate properly, it is impossible to run these applications on resource-constrained devices like wireless handsets, by contrast, Compact NetFront, is a very compact and clean HTML browser.

Though the code size for Compact NetFront is only 300K bytes, its functions are very near to those of PC browsers. The functions for Compact NetFornt include HTML browsing, GIF image (including animated GIF) display, form input, URL input, bookmarks, history management, screen memo, content cache, file download and so on. More than 10 million handsets with Compact NetFront have been shipped through January 2001. Compact NetFront offers the following features:

- Small memory footprint:
- ROM 300KB/RAM 150KB
- Compact HTML support
- GIF and animated GIF support
- PNG and JPEG as options
- Optimized for low power CPU: 5-15 MIPS
- Easy button operation – 4 button combination
- Direct key assignment – accesskey attribute
- Telephony URL support (tel: xxx-xxxx-xxx)
- CPU/OS independent
- Communication protocol independent
- SSL (AVE-SSL) and Java (JV-Lite2) as options
- Flexible UI customization

Compact NetFront for i-mode is implemented on top of the light transport protocol stacks designed for the PDC (Personal Digital Cellular Telecommunication System) packet network. Another example in Japan is the "dot.i" service of PHS operator ASTEL. In this case, a Compact NetFront browser runs on HTTP, TCP/IP over the PHS network. Figure 2 shows the software architecture.

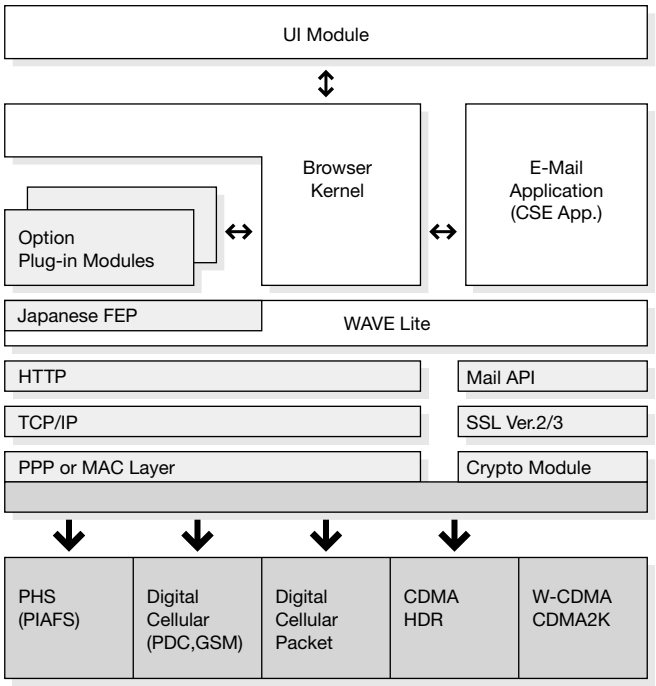


Figure 2. Compact NetFront Software Architecture

Highly Integrated with Mobile Phones

Compact NetFront can be highly integrated with mobile phones. While browsing the net, users can receive a voice call, then immediately switch to the voice dialog, and they can move back to the browsing screen after the voice dialog. To accomplish this, Compact NetFront tasks can be controlled via “Stop” and “Restart” events.

And, the telephone call function can be invoked from the browser. When “tel:” schemes in the HTML content or e-mail messages are selected, Compact NetFront calls the telephone call function by the specified telephone number.

2.3 Is i-mode Proprietary Technology?

As described above, i-mode service is based on HTML and HTTP. In this sense, it is an open approach based on Internet standards. The telephony URL used in i-mode is based on IETF RFC [7]. In addition, standard secure protocol SSL [8] is used for secure connections. For transport protocol, an efficient light protocol was developed that depends on the target PDC Packet Network. This decision was made in order to realize an efficient connection over 9.6 kbps packet network.

To summarize, i-mode for PDC-P uses the following public specifications:

- Compact HTML
- HTTP
- SSL
- Telephony URL

In addition to the definition of the markup language and protocols, i-mode defines the running guidelines for the service as follows:

- Size of contents (with max image size)
- Size of e-mail message
- Type of download contents: Image, Melody, …
- Icon character set
- Others

These guidelines are helpful to operators, handset makers, server vendors and content providers.

What are the success factors for i-mode?

There are several factors why i-mode service has attracted so many subscribers (many of them are active users) so quickly. Generally speaking, young Japanese people like an intelligent device that is also cute. But this is not the only reason for the success of i-mode. The three major reasons for the great success of i-mode are:

(1) Internet standards-based technology
As described above, the adoption of HTML, HTTP and SSL attracts the attention of the entire Internet development community. Content providers can leverage their existing content to develop i-mode content. By contrast, WAP content providers have to learn new technologies to develop WAP content.

(2) Packet data communication
DoCoMo's i-mode uses PDC (packet data communication). Even though it is relatively slow (9.6 kbps), users have a feeling that their handsets are continuously connected to the network. They do not have to worry about airtime charges for browsing the Internet or sending e-mails.

(3) Business model
For content providers, the business framework and billing system is very important. DoCoMo charges a content subscription fee to subscribers with voice and packet charges. This enables even small content providers to make money from their content.

In addition to the above points, Japanese handset makers are very good at developing attractive, small, light and easy-to-use devices with an integrated micro browser.

3. Compact NetFront Plus

3.1 Design Goal

Compact NetFront Plus is the extended version of Compact NetFront designed to support WML 1.3 and XHTML Basic. XHTML Basic became a W3C recommendation in December 2000, and it is expected to become a core language for the WAP 2.0 (WAP-NG) markup language. The principal added features of Compact NetFront Plus are as follows:

- Compact HTML and XHTML Basic support
- WML 1.3 support (native support)
- GIF, animated GIF and WBMP support
  PNG and JPEG as options
- HTTP support
- Wireless TCP support
- SSL (AVE-SSL) and Java (JV-Lite2) as options

Compact NetFront Plus interprets Compact HTML, WML and XHTML from received data and displays it in a suitable format. WML native support means that Compact NetFront Plus can browse existing WML content without binary conversion. Figure 3 shows an example of Compact NetFront Plus displaying WML components. The soft key label is displayed at the bottom line. Compact NetFront Plus displays WML components in similar HTML components in order to avoid confusing users. The browser can jump to a WML site linked from an HTML site and it can also jump to the HTML site linked from WML sites.

Compact NetFront Plus can be integrated with HTML/HTTP based e-mail applications or SMTP/POP3 based e-mail applications. There are a several implementation methods for "push messages" (notifications of e-mail arrival), an SMS-based push mechanism is one example.

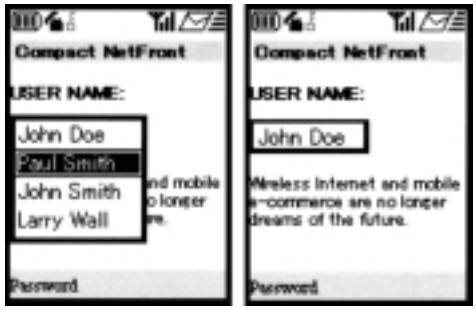


Figure 3. Displaying WML Contents by Compact NetFront Plus

3.2 Software Architecture

Compact NetFront Plus inherits “compactness” and “portability” from the original Compact NetFront code. The software architecture of Compact NetFront Plus is the same as that in Figure 2. Compact NetFront Plus can be used for any kind of wireless communication environment.

As illustrated in Figure 2, WAVE Lite works as an abstraction layer of a simple window system. The hardware dependent part of WAVE has to be ported to specific hardware. For 2.5G and 3G high-speed data transfer mode, multimedia functions such as streaming audio and video (for example, MPEG4 video) could be plugged into Compact NetFront Plus through the plug-in interface.

3.3 Network System

The network system configuration for Compact NetFront Plus is shown in Figure 4. A handset becomes an IP (Internet Protocol) terminal and then a TCP connection between the handset and the gateway server is established.

The gateway server acts as a proxy server. It does not do protocol conversion at all. On the other hand, a WAP gateway server does convert protocols (HTTP, TCP/IP -> WSP, WTP) and content (binary transcoding: WML text -> binary data). This is a specific point of differentiation between a standard proxy server and a WAP gateway server. In addition, an end-to-end SSL connection can be established between the handset and the content server through the SSL tunneling function [9] of the proxy server. This means that existing secure servers on the Internet can be used without modificaion. Advanced e-commerce and e-banking services can be accessed by mobile phones using Compact NetFront Plus.

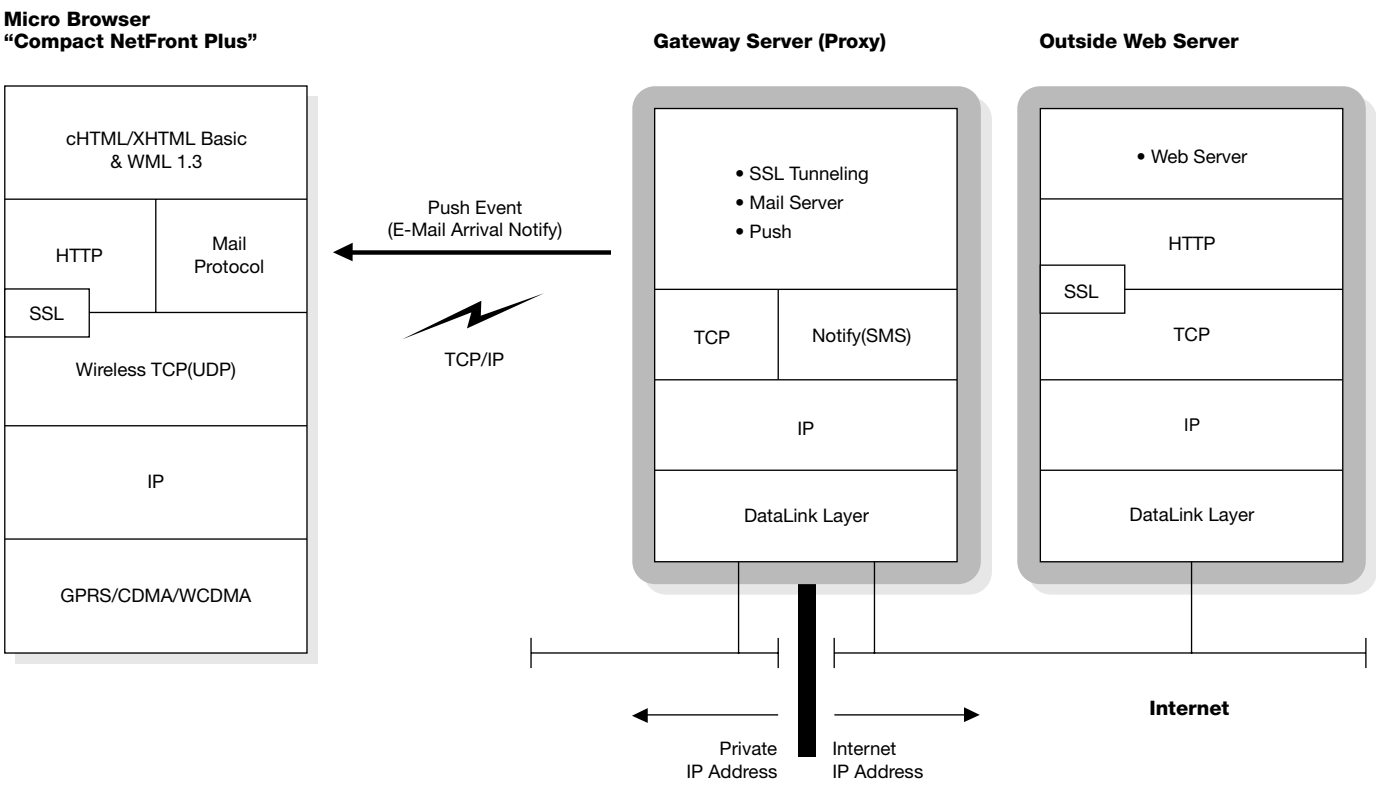


Figure 4. Compact NetFront Plus - System Configuration

3.4 Integration with WAP Environments

Figure 5 shows an example of an extended system coupled with an existing WAP 1.x environment on
a GSM/GPRS network system. New handsets with Compact NetFront Plus can access existing WML content and they can also access rich and colorful content based on Compact HTML and XHTML. Note that Compact NetFront Plus can parse and interpret WML text that is seamlessly transferred from a WML content server through a proxy server. With Compact NetFront Plus, a single browser can handle multiple markup languages.

Figure 5 shows an example of an extended system coupled with an existing WAP 1.x environment on a GSM/GPRS network system. New handsets with Compact NetFront Plus can access existing WML content and they can also access rich and colorful content based on Compact HTML and XHTML. Note that Compact NetFront Plus can parse and interpret WML text that is seamlessly transferred from a WML content server through a proxy server. With Compact NetFront Plus, a single browser can handle multiple markup languages.

The overall system architecture in Figure 5 is similar to that of standard ISP systems. When a "virtual operator" wants to run their own portal, they can do so easily by connecting the portal to the proxy server of a physical wireless operator. In addition, when a wireless bearer network is upgraded to 3G, the entire system on the top of the IP network can be upgraded by replacing only the base-band part. This architecture for wireless Internet access matches the **"IP roaming"** concept.

In a GPRS environment, GGSN allocates IP address to a handset. The protocol layer of the Compact NetFront Plus solution is illustrated in Figure 6. It should be noted that content data is transferred without conversion.
A similar system can be built for CDMA, HDR, W-CDMA or other network environments. In the case of a circuit switch network, PPP (Point-to-Point Protocol) is used under the TCP/IP protocol.

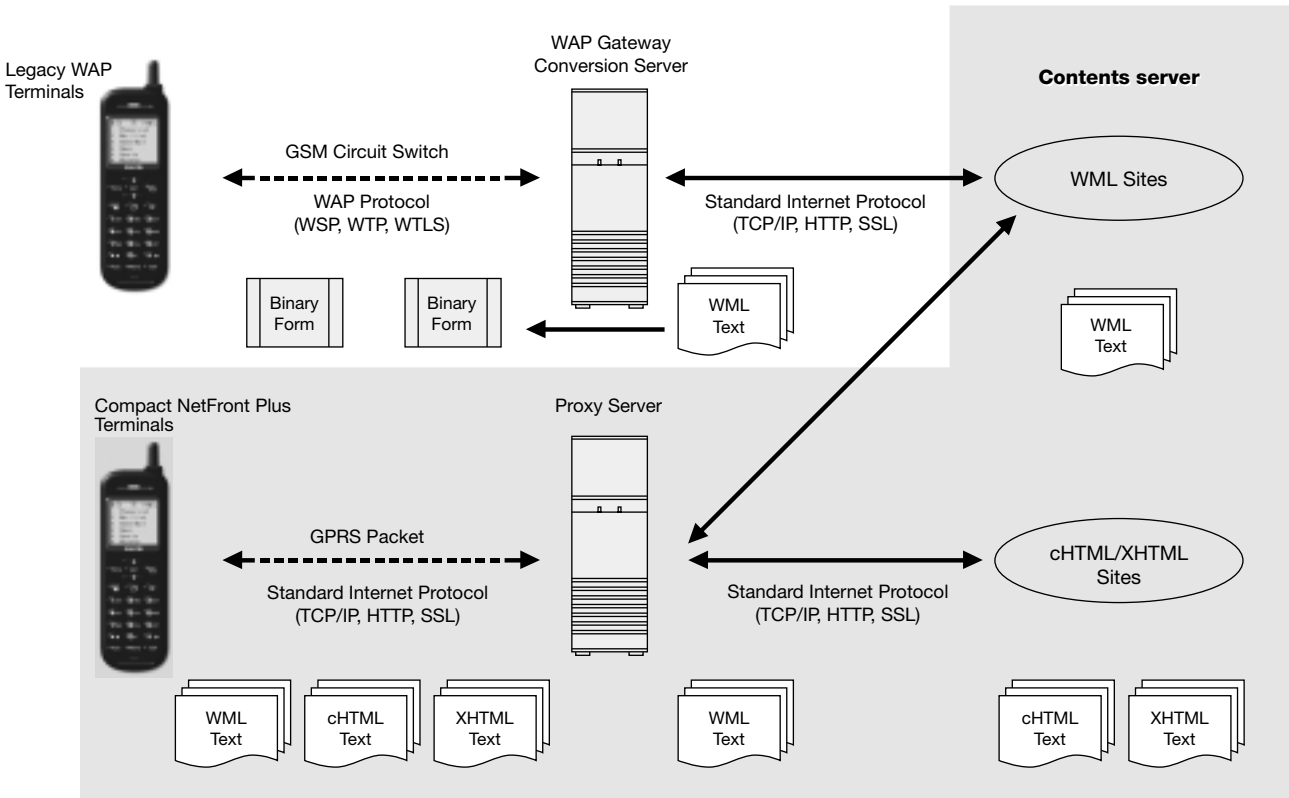
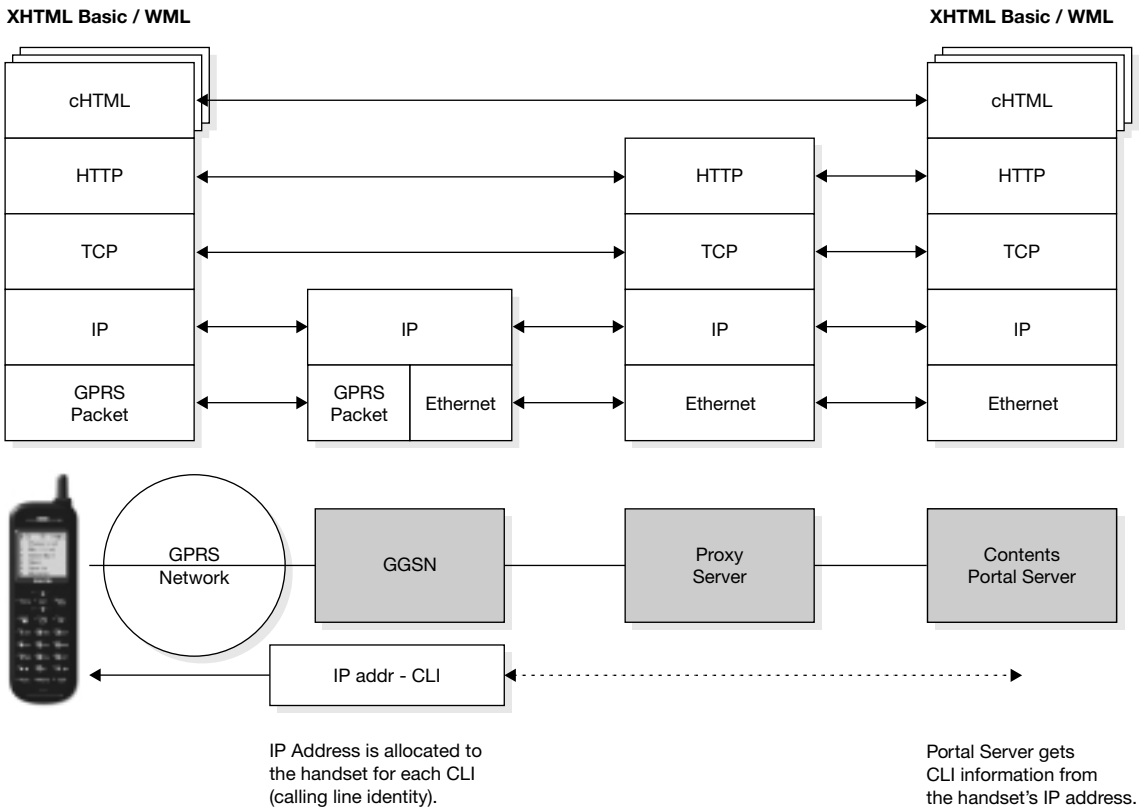


Figure 5. Compact NetFront Plus for GPRS Environment

Figure 6. Compact NetFront Plus - Protocol Layer

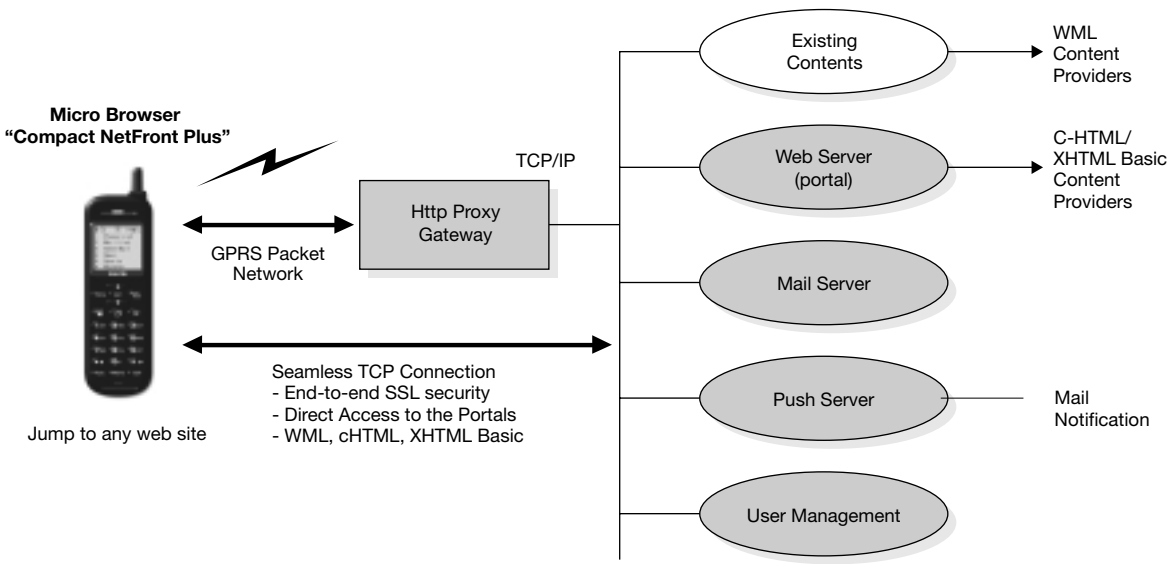


3.5 Server System

Figure 7 shows the server system for the Compact NetFront Plus solution. This is a TCP/IP based local network inside the wireless operator's environment.

The system consists of several servers such as a content portal server, mail server, push server, user management server and billing system. System integration depends on the wireless operator's environment. For example, a push server controls SMS push management to send SMS data for notification of e-mail arrival.

Figure 7. Server System for Compact NetFront Plus



4. Benefits of Compact NetFront Plus

Compact NetFront Plus brings benefits to all participants involved. It can be called a “win-spiral solution”. The wireless Internet market is expected to grow rapidly matching and even surpassing the growth of the Internet over the past 5 years. ACCESS summarizes the benefits for each participant as follows.

(1) Operators

The necessary investment for building a server system is small compared with a WAP gateway approach. The WAP gateway approach requires a powerful server, more powerful than a standard proxy server because of the protocol conversion and contents conversion. As the number of subscribers increases, a WAP gateway’s processing ability has to be increased. Operators can make money from packet traffic and charge for content services with a small investment. The Compact NetFront Plus solution also works well for virtual operators.

(2) Handset Makers

Compact NetFront Plus can support all necessary markup languages (Compact HTML, WML, XHTML Basic) with one single browser. Handset makers can reduce memory size requirements, compared with a multi-browser approach. This brings a reduction of hardware cost, creating the opportunity for developing value-added handsets.

(3) Contents/Service Providers

Content providers can use their existing content based on HTML/XHTML and share their existing servers for wired and wireless Internet. If they run services for PCs and handsets, much of the content can be shared. When content providers already have WML content, they can continue to use it. And for secure transaction services, an SSL-based standard server can be used as is.

(4) End Users

End users can enjoy rich entertainment content and use convenient information and services, anytime, anywhere from mobile phones, especially location-based services. By using Compact HTML, end users can even easily make their own home pages for access from mobile phones.

5. Concluding Remarks and Future Directions

Compact NetFront Plus provides a clear transition path towards 3G wireless Internet services while protecting the investment made for existing services. WAP-NG (2.0) is expected to be compliant with Internet standards. ACCESS is serving as an Editor for WAP 2.0 specifications, and ACCESS will continue to help define the specifications and release the products that meet the future requirements from the consumer market.

The future of the mobile phone describes a “magic device” by which users can do everything. As handsets incorporate more processing power and memory, they could offer richer functionality. But the progression to mobile phones that provide advanced Internet technologies like streaming audio and video will be gradual due to a combination of cost constraints, shape, weight, battery life, and other factors.

Our view for the future of the mobile phone is that of an advanced IP terminal. IPv6 (IP version 6) support will be an essential requirement. Voice data will likely be transferred over IP. Another possibility is the integration of digital broadcasting— the wireless delivery of voice and data will be mixed with the digital broadcasting of video (TV) and data.

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