cdmaOne Cellular Phone and WAP Contents Service

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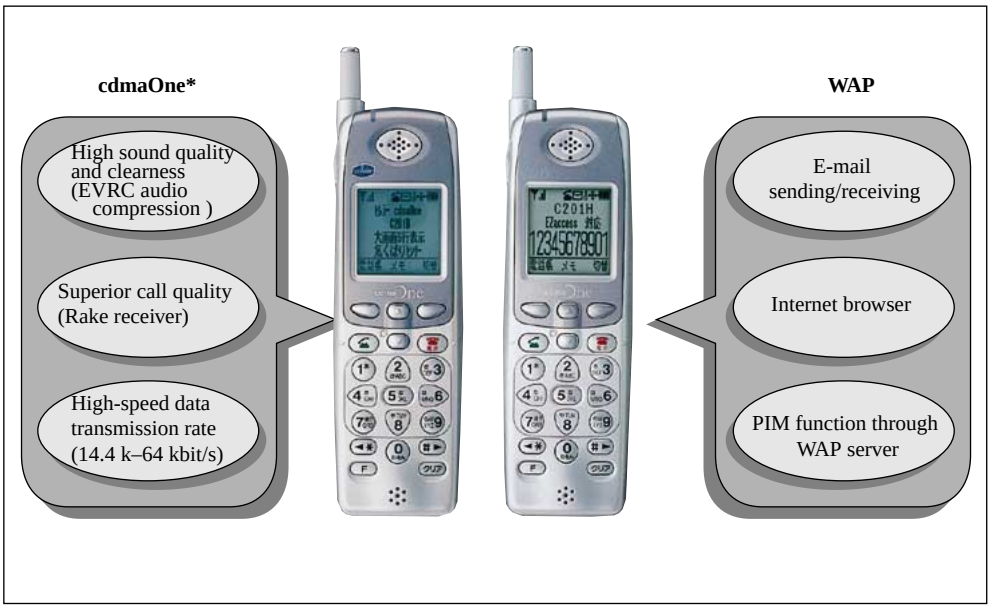
OVERVIEW: The number of mobile phone users in Japan has increased rapidly in recent years, passing the 50 million mark in July 1999. This boom has been triggered by the smaller and lighter terminals with added functions that are now available, and by reduced line charges as well. Mobile phone applications have also increased; they now have e-mail and data communications capability, in addition to handling ordinary telephone calls. There is, however, a demand for mobile phones that can more easily enable users to download news and other information from the Internet. In the midst of this boom, a new type of mobile phone service called "cdmaOne" began to be offered locally in 1998 and on a nationwide basis in April 1999. cdmaOne, a worldwide uniform standard, is a digital mobile phone service with superior basic performance, including excellent sound and call quality, and high-speed data communication capacity. Hitachi, Ltd., believing that future mobile phones would need to provide not only superior telephone performance but also e-mail and Internet access services, has adopted a communications protocol called WAP (wireless application protocol) developed specifically for viewing information by mobile phones, and has developed the C201H cellular phone utilizing the protocol to enable the offering of such services. Since the C201 first went on sale, services to provide users with databases and data contents through WAP have been available and have gained widespread acclaim.



EVRC: enhanced variable rate codec
WAP: wireless application protocol
PIM: personal information manager
*cdmaOne is a registered trademark of CDG (CDMA Development Group).

Fig. 1— cdmaOne Cellular Phone "C201H" for WAP Service.
The C201H is a cdmaOne cellular phone with excellent sound and call quality, equipped through WAP with e-mail and Internet access capability.

INTRODUCTION

MOBILE telephone service first became available in Japan in 1987. Since then the entry of new equipment manufacturers into the market and the switch to digitization have brought many new services to users. During that time phone terminals became smaller and lighter, and service charges were lowered with the introduction of the terminal sell-off system. These factors brought about a rapid expansion of the mobile phone market, and since 1996 the number of subscribers has been increasing by about 10 million annually. The introduction of the cdmaOne terminal in 1998 brought further new services to users, and Japan's mobile phone population, including PHS (Personal Handyphone System) users, passed the 50 million mark in July 1999.

There are two principal categories in the mobile communications environment, "audio calls" and "data communications." In April 1998, the number of times mobile phones were used for data communications purposes was only 2.4% of the number of times they were used for making calls. By April 1999 that number had increased tenfold, and the percentage relative to calls had risen to 13.6%. The short message service was used in 93% of the cases, indicating that the use of mobile phones for sending e-mail was on the increase.[1)] At the same time, the increasing popularity of the Internet was creating a demand for mobile phones that could enable users to log onto the Net more easily.

It was in response to these market trends that the C201H cdmaOne cellular phone was developed and the WAP communication protocol for it was introduced. This paper gives an overview of cdmaOne and WAP and describes the features of the C201H terminal.

cdmaOne OVERVIEW

cdmaOne is a digital cellular phone service that utilizes the communications technology CDMA (Code Division Multiple Access). The spread spectrum technology used in CDMA gives it high call security and an excellent capacity to eliminate interference waves, for which reasons it was originally developed for military use. The U.S. company QUALCOMM then began doing research on applying it to mobile phones, and in 1993 it was adopted as the "IS-95" standard for digital cellular telephone service in North America. It was used to provide commercial services in Hong Kong, South Korea, and North America, and in July 1998 Japan adopted it to provide service in the Kansai, Kyushu and Okinawa areas through the DDI-Cellular Group[*1]. In April 1999 it became available in other areas, and has since become available nationwide

PCC: personal digital cellular telecommunication system
AMPS: advanced mobile phone service
PCS: personal communications service
GSM: global system for mobile communications
W-CDMA: wideband code division multiple access

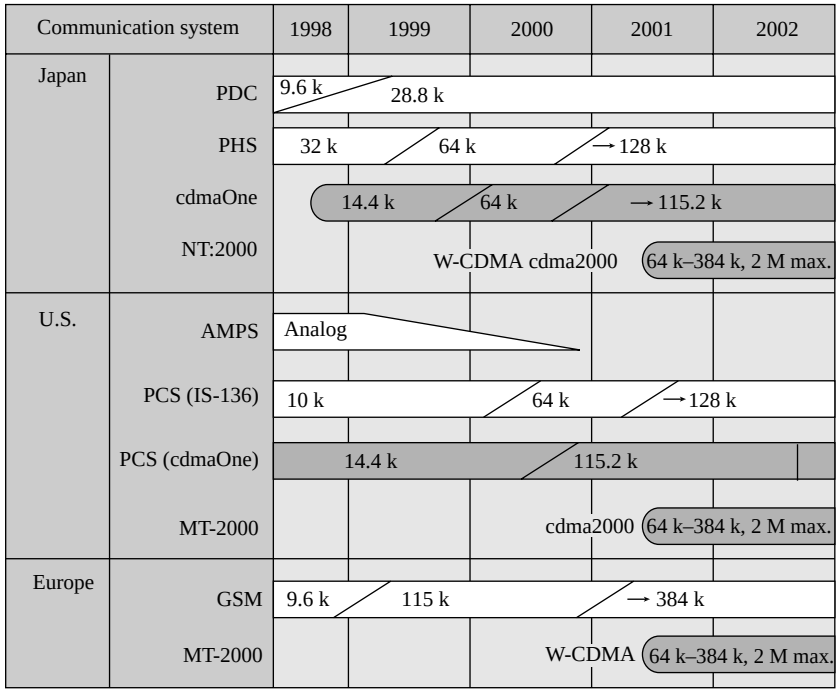


Fig. 2— Communication Systems and Trends in Data Transmissions. Future forecast is for higher data transmission speed (bit/s) and more services provided through the use of CDMA technology.

*1 The DDI-Cellular Group comprises DDI Corporation and Hokkaido, Tohoku, Hokuriku, Kansai, Shikoku, Chugoku, Kyushu, and Okinawa cellular telephone companies.

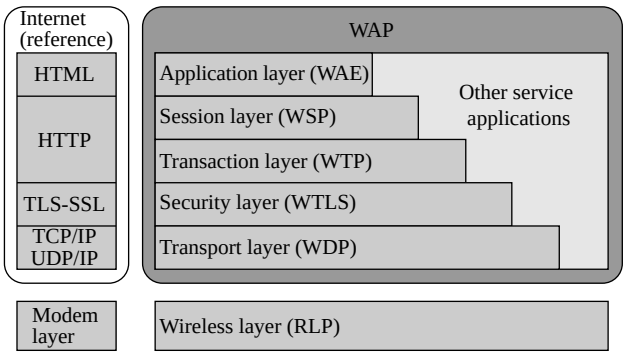
with the beginning of new services provided by IDO Corporation and DDI-Cellular Group.

With the advocacy of the US's CDG (CDMA Development Group), the mobile phone services based on IS-95 are called "cdmaOne." In Japan the services are provided through the use of the IS-95-based ARIB STD-T53 standard with the advocacy of the Association of Radio Industries and Businesses.

Fig. 2 shows communication systems and trends in data transmissions speed for mobile phone services offered in different parts of the world. In the future all the systems will offer higher transmission speeds, and the use of CDMA systems such as IMT-2000 (International Mobile Telecommunications-2000) will enable a variety of new services to be provided.

The notable features of cdmaOne are as follows.
(1) Its ciphers for signal spreading perform the function of coding messages, with extremely high message security obtained as a result.
(2) It uses the new voice compression technology "EVRC" to provide superior sound quality and clearness.
(3) It uses a "rake receiver" to receive compounded electric waves transported over a variety of routes, resulting in improved communication quality (path diversity effect).
(4) Since with CDMA it is possible to switch base stations while communicating simultaneously with multiple base stations, breaks in communication are rare (soft handoff function).
(5) It can communicate data at a high speed of 14.4 kbit/s, and will soon be offering new communication services through the use of 64-kbit/s packet switching.

As a next-generation digital cellular phone service, the CDMA system can be expected to become a de facto standard like GSM. Hitachi, Ltd. has accordingly proceeded with the development of cellular phones employing this system.



HTTP: hypertext transfer protocol
TLS: transport layer security
SSL: secure socket layer
TCP: transmission control protocol
UDP: user datagram protocol
IP: Internet protocol
WAE: wireless application environment
WSP: wireless session protocol
WTP: wireless transaction protocol
WTLS: wireless transport layer security
WDP: wireless datagram protocol
RLP: radio layer protocol

Fig. 3—WAP Protocol Stack Structure.
Structure comprises protocol stack layers for connections and an application layer for functions.

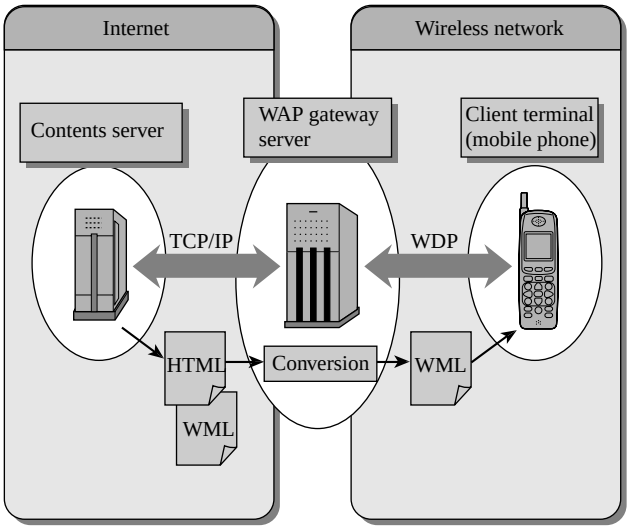


Fig. 4—Basic Network Structure.
Wireless network is connected to the Internet via WAP gateway server.

WAP OVERVIEW

The wireless application protocol (WAP) is a global telecommunications protocol standard that enables mobile phone users to easily access Internet information. It was developed by the WAP Forum, an industry association founded by Ericsson, Motorola, Nokia, and Phone.com, Inc. (formerly Unwired Planet).

There are four major problems in using mobile phones to display Internet information, as follows:
(1) The CPUs in mobile phones generally have low processing power, making it difficult for them to process HTML, the hypertext markup language used on the Internet.
(2) Mobile phones have small memory capacity, and cannot handle data for which a large memory is required.
(3) The display screen is small in size, and the number of input keys is limited.
(4) Wireless communication speed is generally low.

WAP was developed under the premise that mobile phones had these inherent disadvantages. The structure of the WAP protocol stack is shown in Fig. 3, and the basic structure of the network over which service is

provided by WAP is shown in Fig. 4.

The protocol can be broadly divided into two categories: protocol stack layers providing connections (WDP, WTLS, WTP, WSP) and an application layer (WAE) providing functions. The application layer uses WML (wireless markup language) instead of the Internet's HTML.

The principal features of WAP standards are as follows.

(1) Thin client design

The server has all of the data processing and storage functions, while a terminal has only input and display functions. Thus there is no need for the terminal to handle complex data and even a low-capacity CPU becomes sufficient. This also eliminates the need for a large-capacity memory, lightening the load on the terminal and enabling extra functions (phone directory, scheduler, etc.) to be provided.

(2) WML designed for portable terminals

WML was developed assuming a small screen size and a limited number of keys. Operations requested of the screen can be flexibly allocated with buttons known as "soft keys," thus enabling necessary operations to be performed with a limited number of keys. Telephone-oriented functions like one-touch calling of designated parties can also be implemented, and provided services can be easily expanded.

(3) Implemented card and deck concepts

With WML, the data on a single screen, called the "card," is transmitted in multiple groups of data units called "decks." This enables high-speed movement from one card to another. Furthermore, the server can only be accessed during movement from one deck to another, and this lightens the traffic volume and thus the load on the server.

(4) Transmission via binary WML

WML descriptions comprise binary data that is compressed and transmitted. It is smaller in volume and more compact than Internet data, thus the slowness of its transmission speed is somewhat alleviated.

As a result of these features, the problems inherent in using mobile phones to display Internet data are solved. Wireless networks are connected to the Internet through WAP gateway servers. Internet data contents are converted into WML at the server and forwarded to terminals. Since the terminals can also be used to send and receive e-mails, and to create personal databases for phone directories, schedules and the like, they have a great many of the functions provided by a conventional PDA (Personal Digital Assistant).

Hitachi mobile phones provide WAP services via a WAP inspection program (UP browser) made by Phone.com (formerly Unwired Planet), the company that developed the original form of the WAP standard.

TABLE 1. C201H Main Specifications

C201H, the first mobile phone in Japan able to provide WAP service, combines superior performance and high functionality.

Item	Specifications
Size	42 mm (w) × 18 mm (d) × 130 mm (h)
Weight	82 g
Continuous call time	120 min (standard test conditions)
Continuous standby time	150 h (standard test conditions)
Display	Em 10 characters × 5 lines
Memory dial	500 items (e-mail address/notes can be input)
Ring tones	11 melodies (2 can be self-created)
Other functions	• Message memory function • Manner mode function • Short message send/receive function • WAP service

C201H OVERVIEW AND WAP SERVICE

An outline of the Hitachi C201H mobile phone and the services it provides are described in this section.

C201H Overview

Table 1 shows the main specifications of the C201H phone. The terminal holds a QUALCOMM-made chip baseband processing LSI comprising a CDMA processing circuit, CPU, and DSP (digital signal processor). The main ICs are mounted in a CSP (chip size package), and high integration and lightness in weight are achieved through the use of a multi-layer resin base with IVHs (inner via holes) in each layer. RF and baseband components are mounted on a single PCB, enabling a thickness of only 18 mm to be achieved. Fine quality texture is achieved through use of a metallic design. Providing of WAP service is made possible by the terminal's UP browser, the first of its kind in Japan's domestic mobile phone industry.

WAP Service Details

The WAP services EZaccess[*2] and EZweb[*3] became available at the same time the C201H went on the market. These services provide the following functions:

*2 EZaccess is a service trademark of IDO Corporation.
*3 EZweb is a service trademark of the DDI-Cellular Group.

TABLE 2. Main Contents Provided by WAP
Wide variety of information is provided.

Category	Contents
News	Major news stories, sports, weather, stock market
Guide	Shops, events, parking spaces, music, cinema
Search	JR timetables, routes, company phone numbers
Amusement	Fortunetelling, quizzes, games
Shopping	Banking, ticket sales, flight reservations
Communication	Message boards, friendship clubs

JR: Japan Railways

(1) Browsing of Internet contents (EZ Internet)
(2) E-mail sending/receiving
(3) Address ledger, schedule, task list databases (EZ PIM)

The principal contents provided by "EZ Internet" are shown in Table 2. As the table shows, information is provided on a wide variety of fields. The e-mail function allows for sending and receiving of messages via the Internet. And the EZ PIM service allows users to create individual databases for telephone ledgers, schedule, task lists and so on. Providing these services to the user enables the mobile telephone to function as a true information terminal.

CONCLUSIONS

This paper gave an outline of the cdmaOne mobile phone service and WAP communications protocol, and described the C201H cdmaOne mobile phone developed by Hitachi, Ltd. and its features.

In the future, the mobile telephone market is expected to see the development of new systems capable of transmitting large volumes of data at high speed, enabling multimedia transmission to be put to practical application. Such phones will be needed because customer needs for the transmission of information other than simple voice data are increasing rapidly in the mobile phone field. Hitachi, Ltd. will continue to work to develop mobile phones to meet these needs.

REFERENCES

(1) Nikkei market access survey (August 1999)
(2) http://www.wapforum.org/
(3) http://www.ido.co.jp/cdmaone/ez/service/
http://www.ezweb.net.jp/

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