The Personal Handy Phone System in Japan's Wireless Communication Market

Application Note

System and Market Overview

The Personal Handy Phone System (PHS) offers a new, lower cost alternative for digital communications. Developed for Japan's booming cellular phone market, PHS is now being marketed outside the country, particularly in Asian countries.

This paper briefly surveys the Japanese wireless marketplace and positions PHS relative to other popular digital communication systems. This paper also introduces HP's test products for PHS.

Wireless communications in Japan today

Japan's wireless communication market has boomed since the government deregulated the sale of cellular phones in April 1994 and of pagers in March 1995. The number of cellular phone subscribers reached about 8 million by December 1995, with 6 million new subscribers added since the opening of the market. The number of pager subscribers has grown to an estimated 10 million today.

Table 1 on page 2 compares the current and emerging wireless systems in Japan. The country's Personal Digital Cellular (PDC) phone system is based on time division multiple access (TDMA) and frequency division multiple access (FDMA) technologies similar to the TDMA-based North American Digital Cellular (NADC) system in the U.S., although PDC is not a dual-mode system as is NADC. Among the rapidly growing number of cellular subscribers, more than 30% now use PDC

Japan has also recently adopted a new digital paging system to handle the large number of new users as well as new paging applications. The system is called FLEX-TD, and it is based on Motorola's FLEX™ protocols. Commercial FLEX-TD service is expected to begin in Spring 1996.

To compete with established cellular radio systems, three operators in Japan began offering PHS service in July 1995 in cities, railway stations, and shopping areas. One million subscribers are expected in the first year of service. The Personal Handy Phone System is described in greater detail below.

This opening of the wireless communication market in Japan has led to more competition, lower prices for subscriber services, the introduction of new products and services, and a surge of investment in the communication infrastructure. Now the critical business issues for wireless network operators are time to market, cost reduction, and better customer

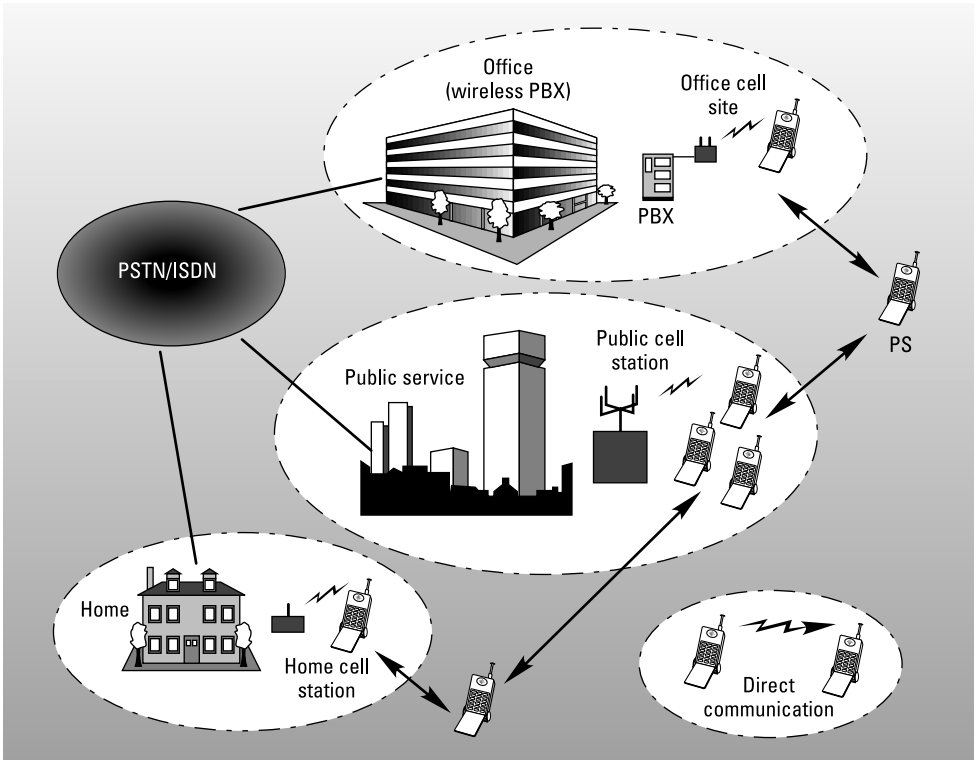
Architecture of the Personal Handy Phone System

PHS is a digital cordless phone system based on TDMA and TDD (time duplex) technologies. It operates in the 1.9 GHz frequency band. The PHS personal station (PS) handset can be used for residential, business (office PBX), and public services. Like conventional transceivers, the system can establish a direct communication link between two PS's without requiring a cell site (see illustration). A similar system that uses TDMA and TDD technologies is the Digital European Cordless Telephone (DECT) system; however, DECT is suited primarily for business use.

PHS uses the existing analog telephone network and ISDN to offer services. The system therefore does not need the same kind of complex network that is required for a cellular radio system such as PDC. This fact enables PHS to offer services priced lower than those of the cellular phone system, and to expand the PHS service area in a very short time.

However, in terms of mobility and cell coverage, the conventional cellular system has an advantage. So most industry observers expect that for voice applications today, the lower service cost but lower mobility of PHS will appeal primarily to customers for personal use, while the higher mobility of PDC will keep that system the first choice of businesses.

For transmitting data, PHS has an advantage over PDC systems. PHS can transmit non-voice data at full rate (32 kb/s), three times the rate of PDC. This ability makes PHS an ideal candidate for data modem applications with laptop PCs and multimedia. In the future, PHS may be incorporated into Personal Digital Assistant (PDA) devices.



Personal Handy Phone System

Table 1. Japanese digital wireless systems

System name	PHS	PDC	D-MCA	FLEX-TD
Type of system	Digital cordless	Public cellular	Digital SMR	Pager
Frequency band	1.9 GHz	800 MHz/1.5 GHz	1.5 GHz	280 MHz
Channel spacing	300 kHz	50 kHz	25 kHz	N/A
Duplex method	TDMA, TDD	TDMA, TDM	TDMA	N/A
Duplex number	4 (full rate)	3 (full), 6 (half)	6	N/A
Bit rate	384 kb/s	42 kb/s	64 kb/s	1.6, 3.2, 6.4 kb/s
Modulation	Pi/4 DQPSK	Pi/4 DQPSK	M-16 QAM	2 FSK, 4 FSK
Mobile Tx power	10 mW avg	3 to 0.3 W peak	< 2 W	N/A
TDMA frame	5 ms	40 ms	90 ms	N/A

Table 2 points out key differences between the PHS and PDC systems. Table 3 compares key specifications of the PHS and DECT air interfaces. The PHS standard air interface and air protocol for public use was developed in 1993 by ARIB (the Association of Radio Industries and Businesses, formerly RCR, the Research and Development Center for Radio Systems) as RCR-STD-28.

PHS Mou under the ARIB is promoting the use of the system outside of Japan, particularly in Asia. Several licenses have been issued in Hong Kong, where PHS is being considered for use as a wireless local loop network as an alternative to expensive wired telephone network infrastructure.

HP's contribution to PHS RF performance testing

The PHS standard includes required performance tests and test procedures for personal stations and cell stations. HP has been working closely with PHS radio manufacturers to develop equipment and application software needed for RCR-STD-28 tests and those required by other bodies as the Radio Equipment Inspection and Certification Institute (called the MKK in Japan) that give type approval and certification to radio communication systems.

PHS custom test system

To optimize its responsiveness to the test requirements of new wireless communication systems such as PHS, HP Japan has set up a local R&D team at its Kobe Instrument Division. The team has introduced a complete PHS test solution that includes a PHS radio communication test system and transmitter testers needed for measuring the performance of PHS handsets and base stations. HP Japan's service engineering organization also builds special custom PHS test systems (see photo on previous page) and software for PHS base station manufacturers and provides consultation services as well.

Table 2. Key differences between PHS and PDC

	PHS	PDC
Base station coverage	Small (100-500 m)	Large (1.5-10 km)
Base station cost	Low	High
Service area	Major cities, spots	Major cities, area
Mobility	Low	High
Voice quality	High	Low
Data transmission	Highly suitable	Suitable
Network structure	Public network	Special network
Cost of service	Low	High
Cost of handset	Low	High

Table 3. Comparison of PHS and DECT air interface specifications

	PHS	DECT
Frequency range	1895 to 1918.1 MHz	1880 to 1900 MHz
Channel spacing	300 kHz	1738 kHz
Duplex method	TDMA/TDD	TDMA/TDD
Duplex number	4	12
Bit rate	384 kb/s	1152 kb/s
Modulation	Pi/4 DQPSK	GFSK
PS Tx power	10 mW avg	10 mW avg
CS Tx power	< 500 mW avg	10 mW avg
TDMA frame	5 ms	10 ms
Voice CODEC	32 kb/s ADPCM	32 kb/s ADPCM

HP 8920 DT digital RF communication test set

The following paragraphs descibe some of HP's PHS test products.

HP 8920DT digital RF communication test system

This test system is designed for high volume production test of PHS (personal station and cell station) or PDC subscriber units, depending on system configuration. The system provides the necessary in-channel testing of the performance of PHS or PDC transmitters and receivers. It can be expanded with other HP test equipment such as the HP 8590 series low cost spectrum analyzers for spurious and other testing.

HP 85726B PHS measurement personality

This measurement personality is a software program on a ROM card for the low cost HP 8590 series spectrum analyzers. The card adds dedicated measurement features for the testing of PHS transmitter performance as required by RCR-STD-28 and for the technical standard conformity certification test procedure specified by the MKK.

HP 89441A Option AYA vector modulation analyzer

This analyzer is the ideal R&D tool for verifying PHS and PDC transmitter signal quality. It provides measurements such as error vector magnitude (EVM) and EVM versus symbols, and operation from dc to 2.65 GHz.

For more information on Hewlett-Packard Test and Measurement products, applications, or services, please call your local Hewlett-Packard sales office. A current listing is available via Web through AccessHP at http://www.hp.com.

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Test and Measurement Organization
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Santa Clara, CA 95052-8059
1-800-452-4844

Canada:
Hewlett-Packard Canada Ltd.
5150 Spectrum Way
Mississauga, Ontario L4W 5G1
905-206-4725

Europe:
Hewlett-Packard
European Marketing Center
PO Box 999
1180 AZ Amstelveen
The Netherlands

Japan:
Yokogawa-Hewlett-Packard Ltd.
Measurement Assistance Center
9-1, Takakura-cho, Hachioji-shi
Tokyo 192, Japan
(81) 426-48-3860

Latin America:
Hewlett-Packard
Latin American Region Headquarters
5200 Blue Lagoon Drive, 9th Floor
Miami, FL, U.S.A. 33126
305-267-4245, 305-267-4220

Australia/New Zealand:
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
Australia
131-347 ext.2902

Asia Pacific:
Hewlett-Packard Asia Pacific Ltd.
17-21/F Shell Tower, Times Square
1 Matherson Street, Causeway Bay
Hong Kong
(852) 2599-7070

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