Digital Cordless Telephone System for Mobile Computing

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OVERVIEW: In this multimedia era, the need for mobile computing is increasing and with it increases the need for access to information sources irrespective of place and time. The PHS (personal handyphone system) information transmission rate is 32 kbit/s, which is relatively fast compared to existing mobile telephone systems. This makes PHS an effective data transmission means for mobile computing, and allows terminals to be used in virtually any locations at home, outdoors and in the office. Hitachi is providing, on a commercial basis, digital cordless telephone systems for offices (office PHS) which allow PHS terminals to be used as extension telephones on the company's premises. Hitachi's PBX (private branch exchange) which is the core of such an office PHS, supports not only speech communications but also 32 kbit/s data communications. This PBX enables users to construct a mobile computing environment by combining a variety of applications.

INTRODUCTION

THE public 32 kbit/s PHS data communication service started in April 1997. Since this transmission rate is relatively fast compared to existing mobile telephone systems, its use is increasing as the data transmission means for mobile computing: e.g., remote access to the intra-company LAN during business trips. This data communication uses a scheme called PIAFS (PHS Internet Access Forum Standard) standardized by the PHS Internet Access Forum.

PHS terminals are also used in digital cordless telephone systems in offices (office PHS) for intra-

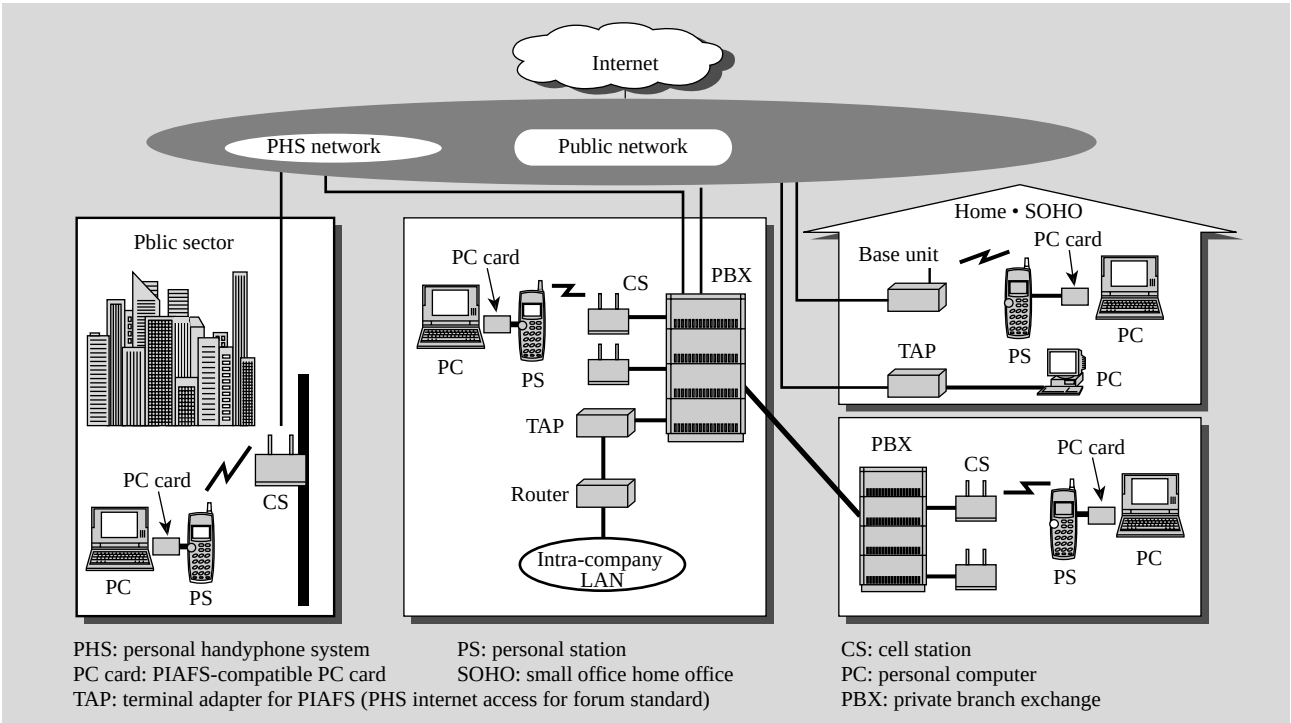


Fig. 1—Configuration of Mobile Computing System Centered on a Digital Cordless Telephone System (Office PHS).
Terminals of an office PHS can be used not only on the company's premises but also in public places and homes within the service area. This enables high-speed mobile computing anywhere and at anytime.

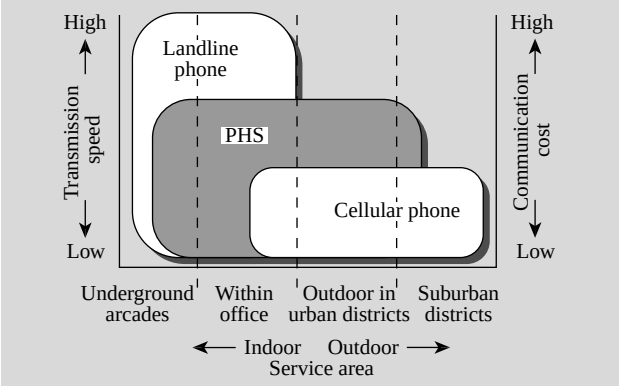
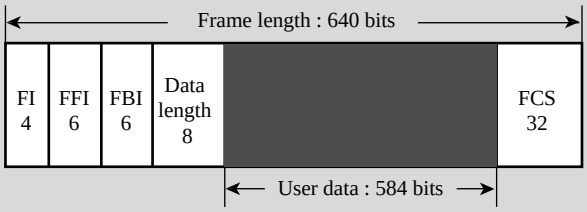


Fig. 2—Positioning of PHS.
PHS allows high-speed data communications at a lower cost not only within the office but also in outdoor locations, including underground arcades.



FI: frame identifier (indicates the category of frame)
FFI: feed forward information (indicates the frame number)
FBI: feedback information (indicates the requested frame number)
Data length: indicates the valid range of the user data area.
FCS: frame check sequence (detects frame errors)

Fig. 3—Data Frame Structure of PIAFS.
PIAFS frames are 640-bit fixed frames that include error detection bits. A total of 584 bits per frame can be used for user data.

company communications. An office PHS allows its personal stations (PSs) to be used anywhere on the premises, if the location is covered by the service area of cell stations (CSs) connected to the PBX or key telephone system. The PS can also be used outside of the office. Hitachi's PBXs serving as the core of such an office PHS support not only voice communications but also 32 kbit/s data communications. This helps implement high-speed mobile computing within the premises. Fig. 1 shows the configuration of the mobile computing system centered on an office PHS.

This article discusses the trends of PHS data communications in mobile computing as well as a system configuration of an office PHS.

TRENDS OF PHS DATA COMMUNICATIONS

Positioning of PHS in Mobile Computing

Fig. 2 shows the positioning of PHS based on comparisons of service area, transmission rate and communication costs[1]. The major advantage expected of PHS is that it allows high-speed data transmission at a relatively low communication cost compared to cellular phones. PHS is an effective communication means for high-speed mobile computing within service areas: in the street, underground arcades, and offices in urban districts. However, PHS is not suitable for use when traveling at high speeds because it is designed for use when traveling at low speeds.

Standardization

For 32 kbit/s data communication in PHS, the PS-CS radio section and the terminal-to-terminal transmission procedure needed to be standardized. The radio standard, RCR STD-28, Version 2 was established in December 1995 by the Association of Radio Industries and Businesses (ARIB). In addition to this standard, the PHS Internet Access Forum was set up in October 1995 for the widespread proliferation of multimedia communications such as Internet access over PHS. This forum instituted PIAFS as the terminal-to-terminal transmission procedure standard in April 1996. Demonstration experiments were then conducted by a number of companies, after which PIAFS was standardized in March 1997. The 32 kbit/s data communication service of public PHS was started in April of the same year. Hitachi included this function in office PHS for commercialization[2].

Overview of PIAFS

PIAFS is a terminal-to-terminal standard for 32 kbit/s data communication in PHS.

Fig. 3 shows the data frame structure specified in PIAFS[3]. PIAFS supports a fixed frame length of 640 bits. As shown in the figure, 584 of 640 bits (excluding bits used for error detection, etc.) can be used for user data. Throughput can be represented by the theoretical maximum transmission rate of (584 bits ÷ 640 bits) × 32 kbit/s = 29.2 kbit/s [4].

PIAFS features the use of ARQ (Automatic Repeat Request). In PHS, bit errors occur at random due to fading*. Therefore, ARQ is suitable because it retransmits only erroneous frames.

*The variation in time of the intensity and/or relative phase of any or all frequency components of a received signal is due to changes in the characteristics of the propagation path. This can be caused by reflected waves on surrounding buildings, interference of multiple waves during traveling, etc.

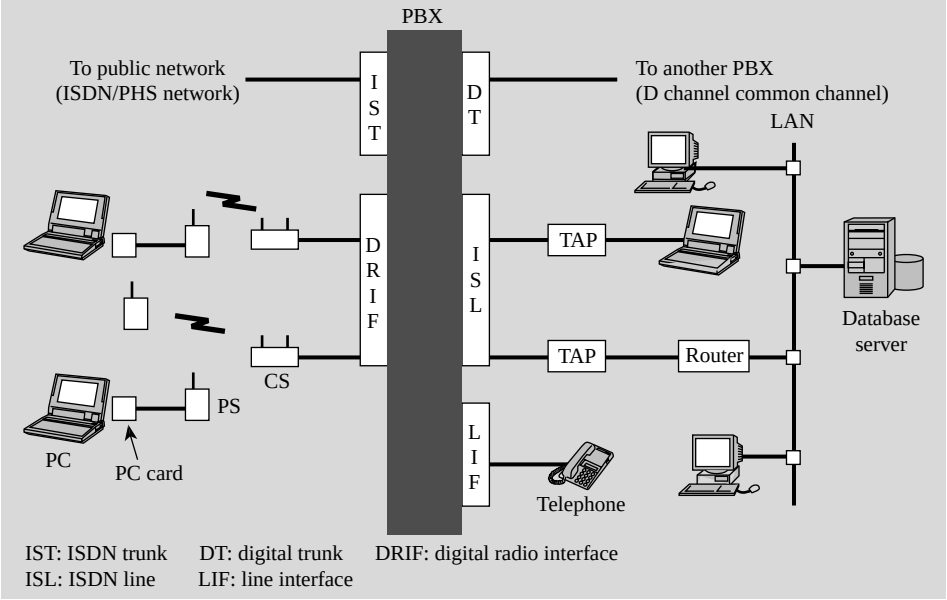


Fig. 4—System Configuration of Office PHS.
The intra-company LAN can be accessed by connecting a personal computer and PS via a PC card for on-premises mobile computing.

OFFICE PHS

System Configuration

Fig. 4 shows an example of the system configuration of a PBX. A PBX supports not only voice communications via wired telephones but also via wireless communications within offices when the CSs are connected to the PBX. The CSs function is to control radio signals to and from PSs. It also enables data communications by using PC cards for PIAFS control and TAP (Terminal Adapter for PIAFS). Furthermore, it allows not only extension connections but also networking by connecting to public networks or PBXs in remote locations.

Uses

(1) Use from other sites

If the corporate network is connected by the D-channel* common channel based on ISDN technology, users can use their own terminal at another site of their company through the support of an inter-PBX roaming function. With this function, users can place or receive calls from the same terminal, at whichever site is available to them at that time [Fig. 5 (a)]. In addition, users can place calls by dialing the same number that they use at their own site without having to be aware of where the called party is. For data communications, users can also access the server at their own site from a remote site. Thus, users can do their work at a remote site in the same way as they can at their own site, irrespective of time and location.

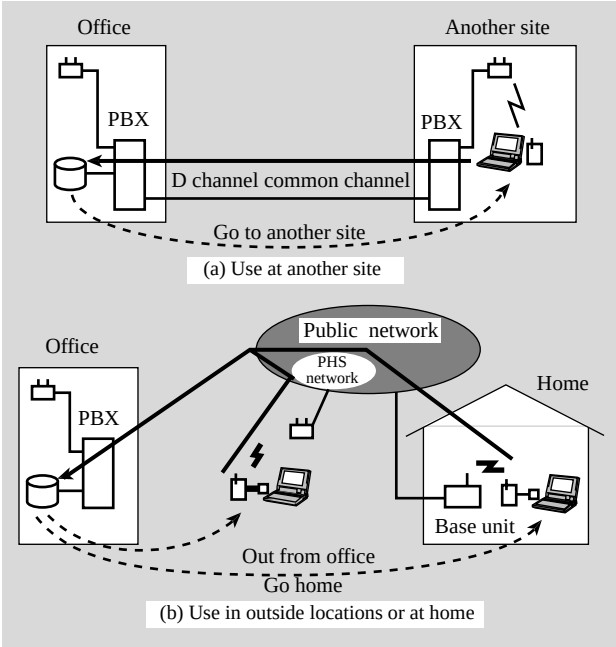


Fig. 5—Use of Office PHS.
Within the radio service area, users can use the PS and information terminal the same way they do in their own office when they are in an outside location or at home.

(2)Use from outside or from home

Even from a location where there is no connection to the corporate network (e.g., places visited on a business trip or at home), users can access the intra-company server by using a terminal which is always used in the office through a public network [Fig. 5(b)].

*D channel: This channel carries information such as telephone numbers and line control.

As long as users are within the PHS service area, they can, for example, confirm information about product inventory while visiting a customer's site or send their daily work report to their home site from anywhere without returning to their own office. This leads to improved work performance and increased customer satisfaction as a result of better service.

In the future, the number of small offices called SOHO (Small Office, Home Office) and telecommuters will increase steadily as more flexible working systems are developed. It is expected that home office equipment such as TA built-in telephones which can be connected to the ISDN network will replace the traditional speech-only telephones at home. PIAFS-based data communication is superior to wireline TAs because it does not require additional cabling and has a high degree of flexibility in the installation location of information equipment.

FUTURE TRENDS

The public 32 kbit/s data communication service started in April 1997, and a 64 kbit/s data communication service is now under study for commercial service.

In addition, experiments on the Multimedia Mobile Access Communication (MMAC) system are underway for transmission rates up to 25 Mbits/s. This radio communication technology will serve as the hub of the next-generation PHS. The goal for implementation of MMAC is the year 2002. If this technology is adopted in PHS, mobile videophones of the same picture quality as in ordinary TV broadcasts will become possible. In the future, PHS will be an indispensable means for multimedia communications.

CONCLUSIONS

This article discussed the trends of PHS data communications in mobile computing as well as the system configuration centering on an office PHS.

Today, the office PHS is widely recognized as an effective tool for intra-company communication, especially as the needs for mobile computing are increasing within companies. Currently, a variety of applications are being implemented using an office PHS which allows high-speed data communications.

Hitachi's goal is to support mobile computing based on the office PHS to meet the needs of users.

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