

Outline of PHS 64K Data Transmission System

DoCoMo realized high speed PHS 64K data transmission service from April 1999.
In this article, the technical outline of PHS 64K data transmission system is described.

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Introduction

In Japan there is a significant increase of mobile data communication users by using PHS and cellular phone. Especially after PHS 32K data communication service was launched in April 1997, number of mobile data communication user is continuously uprising drastically. Also according to the increase of e-mail and Internet users, RAS (Remote Access Server) environment establishment in offices, lighter PC weight, the demand would expand further.

With this market background, DoCoMo has studied higher bit rate of communication speed to meet users' requirements. And we started PHS 64kbit/s data communication service from April 1st of 1999.

This article describes the outline of PHS 64K data communication system.

System Overview

■ Network Configuration

Figure 1 shows DoCoMo PHS network configuration. Unlike cellular phone network, PHS does not have own network but uses NTT's ISDN network.

■ Radio / Network Interface Specification

Radio interface and network interface are specified between CS (Cell Station) and PS (Personal Station), and CS and network respectively. Figure 2 shows reference points of radio interface and network interface. Also it shows channel bandwidth usage example (meshed part is used bandwidth) of each interface at the time of 32/64kbit/s data communication. Each interface is described with comparison to 32 kbit/s data communication.

(1) Radio interface specification

As for radio interface between PS and CS at 64K data com-

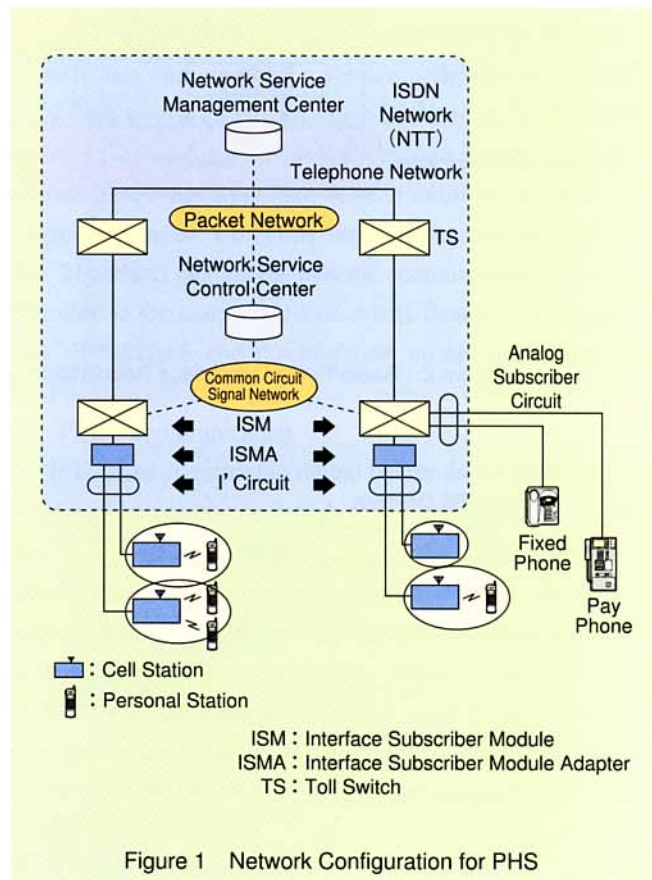


Figure 1 Network Configuration for PHS

munication, it is specified by the second-generation cordless telephone system standard specification (RCR STD-28) version 3 and after. Major additions to conventional specification are as follows;

- Addition of message and sequence for radio slot additional usage
- Addition of the version 3rd protocol version signal
- Addition of 64kbit/s is added to layer 3 information element (transmission capability)

Radio channel multiplexing method for PHS is 4ch TDMA-TDD (Time Division Multiple Access-Time Division Duplex). Voice and 32K data communication uses 1 slot. On the other hand, 64K data communication secures 2 slots simultaneous-

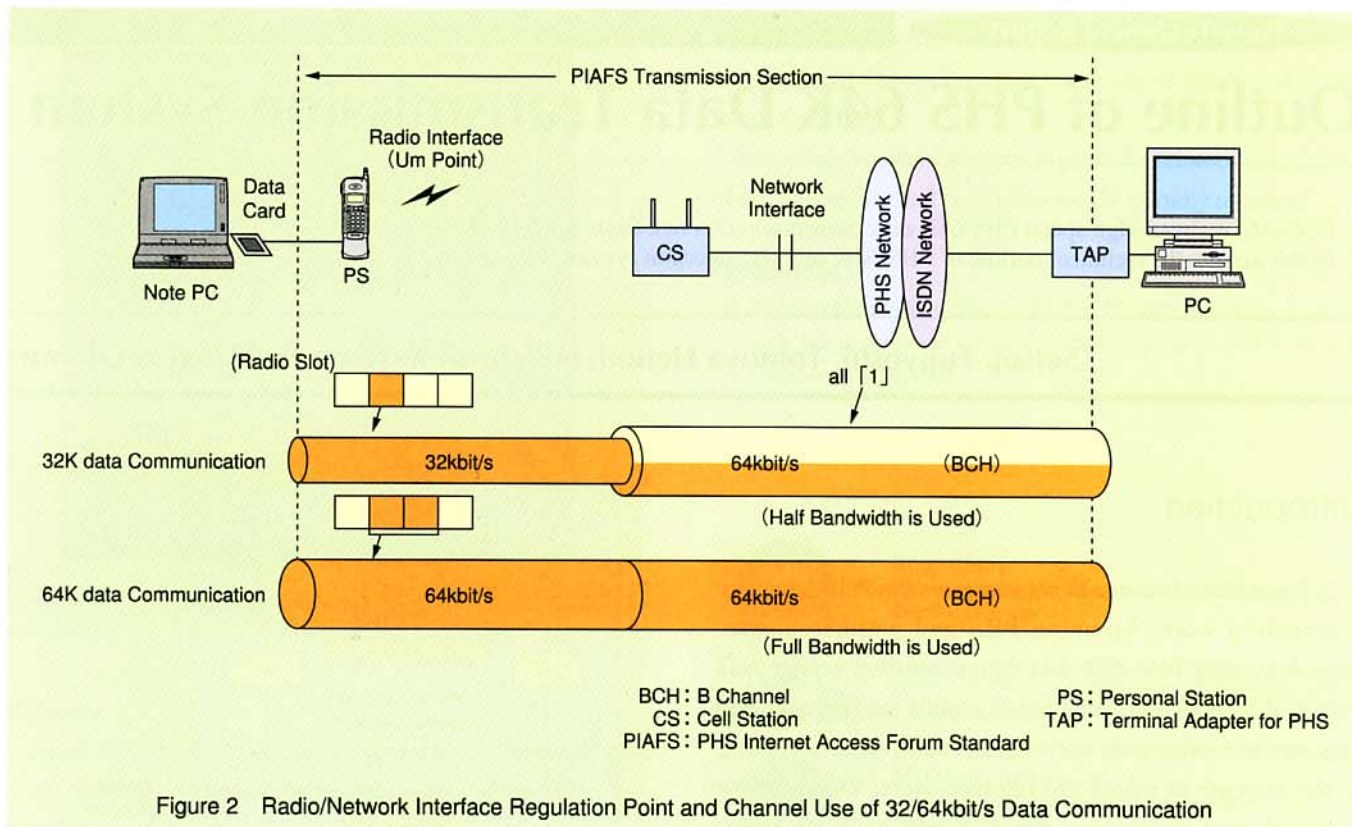


Figure 2 Radio/Network Interface Regulation Point and Channel Use of 32/64kbit/s Data Communication

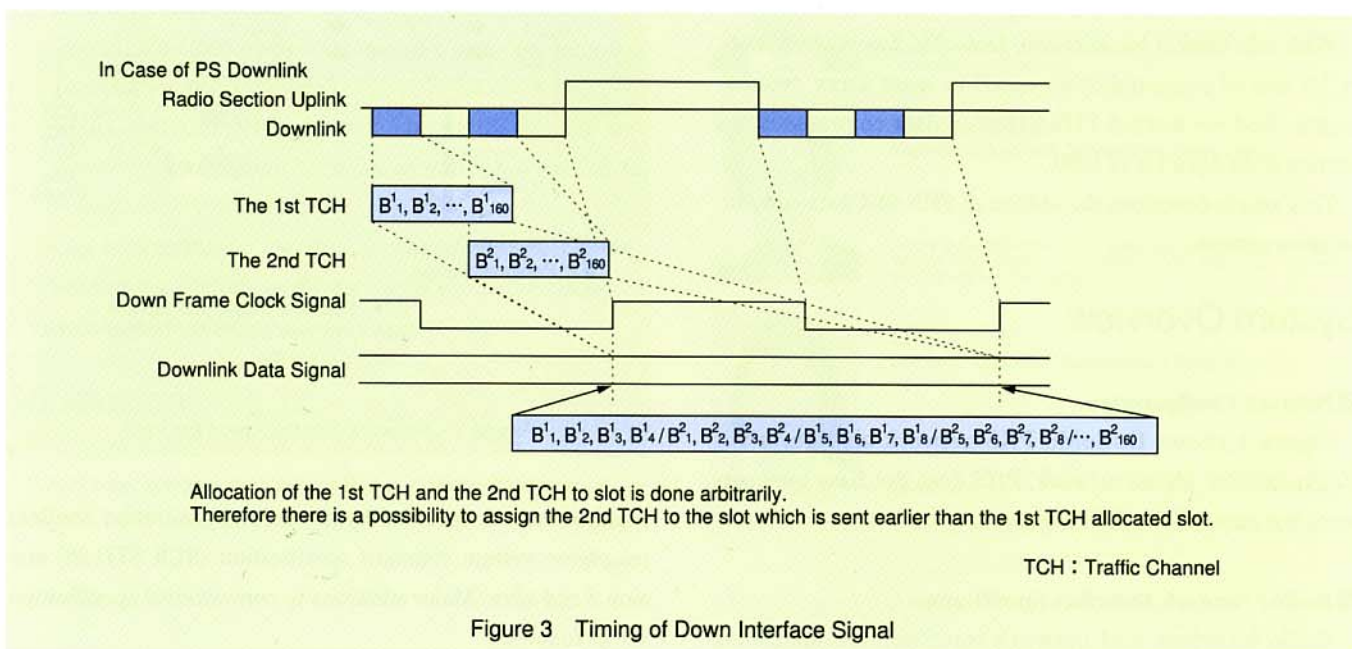


Figure 3 Timing of Down Interface Signal

ly and carries out communication. (Figure 3) TCH (Traffic Channel) is used for user communication. In case of 64K communication, two TCHs are set up for each slot. To identify them, TCH allocated first is called as the first TCH and the other, assigned later, is called as the second TCH. At the time of 64K-call origination, signaling is performed on the first TCH for call control and the second TCH allocation. After entering into communication phase, two TCHs are bun-

dled and used as 64K channel. In case of call termination, by sending additional TCH request direction from CS to PS, CS notifies PS that this is 64K-call termination. When PS receives this notification, likewise origination call process, it sends additional TCH request to CS and secures 2 TCHs. By the way, depending on PS hardware configuration, there is a constraint of 2 slots combination (slot position and frequency) used as 64K data communication. Therefore, PS can noti-

fy supporting allocation method to CS when additional TCH request is sent. Concretely speaking, PS can define whether slot is sequential or every other position, and frequency is the same or not. Also there is a possibility that CS may not secure required 2 slots because of high traffic. In this case, CS returns addition reject. And PS carries out other operation such as reconnection with 32K.

To provide 64K data communication as described above, both CS and PS have to support RCR STD-28 version 3 compliant protocol. However among existing CS, because of hardware capability limitation, some CS can not support 64K data communication. Whether own node supports 64K data communication or not is indicated by downlink broadcast signal, which is sent regularly from CS. In detail, when protocol version of broadcast message indicates version 3, and when available number of slots within the same message is 2, this CS can support 64K data communication. When PS tries 64K data communication, it searches this broadcast signal before call origination and can detect 64K data communication supporting CS.

Another change is the addition of 64kbit/s to information transmission speed of layer 3 transmission capability at the time of 64K data communication.

(2) Network interface

Interface between CS and network of PHS has partial function limitation and PHS specific function enhancement based on I interface. It is specified in TTC (The Telecommunication Technology Committee) JT-Q921-b (layer 2) and JT-Q931-b (layer 3). In case of 32K data communication, one BCH (B Channel) of network side is assigned to one radio slot. In case of 64K data communication, the 1st and 2nd TCHs are bundled and assigned to one BCH. Former case follows TTC standard JT-I460 32/64kbit/s speed matching rule and does user data mapping onto half bandwidth of BCH and inserts 1 for remaining bits. Latter case does mapping onto BCH with-

out speed conversion. Figure 4 shows interworking of layer 3 transmission capability information element. In case of 32K data communication, information transmission speed 32kbit/s is converted to user speed 32kbit/s, user information layer 1 protocol JT-V110/X30, and information transmission speed 64kbit/s. In case of 64K data communication, there is no conversion at CS and user data is sent as it is to network interface.

■ 64K PIAFS Outline

(1) Inband data communication protocol

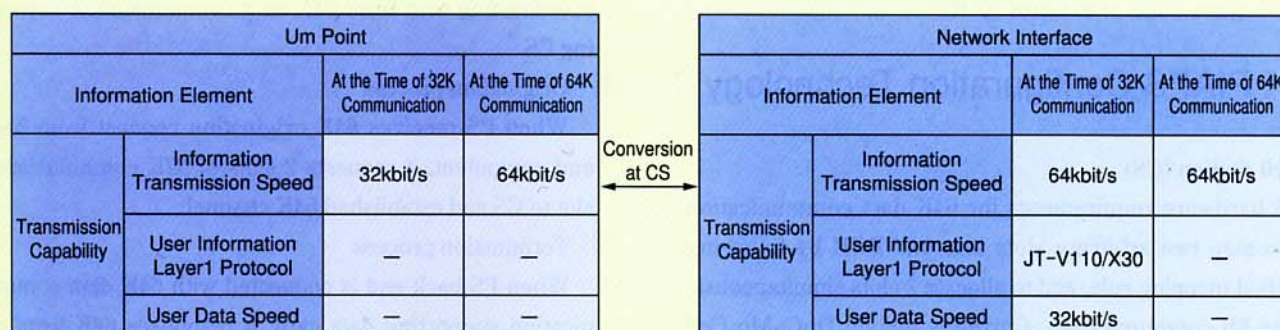
In this chapter, inband data communication protocol used for 64K data communication service is described. Standard PHS data communication specification is PIAFS (PHS Internet Access Forum Standard) using unrestricted digital bearer. PIAFS has upgraded version numbers according to supporting speed. Currently standard completes until version 2.0, which guarantees 64K data communication service. (Enacted in October 1998) Followings describe communication with PIAFS and modification points to realize 64K PIAFS.

(2) PIAFS communication

PIAFS uses unrestricted digital bearer and it provides control procedure to transmit high speed and high quality data. And to support image transmission in the future, it performs inband negotiation. Also it incorporates ARQ (Automatic Repeat Request) transmission control procedure to handle mobile communication unique transmission error. It is the system to do optimum transmission control under the various transmission line delay conditions of domestic/international/satellite. Figure 5 shows frame configuration for PIAFS.

(3) Definition of 64K PIAFS

To define PIAFS specification version 2.0, following points are considered for standardization.



CS : Cell Station

Figure 4 Speed Matching Interwork of Radio / Network Interface

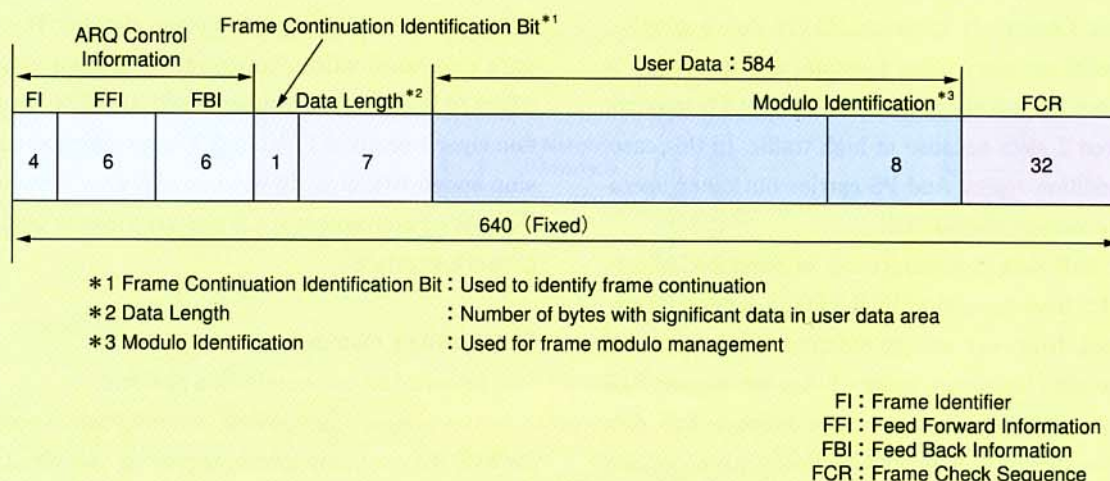


Figure 5 Frame Configuration for PIAFS

- ① Because of traffic condition and interference condition of radio section, it is possible to exist both 64K data communication and 32K data communication for the same user. So 64K PIAFS should have high consistency with 32K PIAFS. (Then it is possible to use 32K PIAFS software and hardware resource effectively.)
- ② 64K PIAFS should have the same configuration as 32K. (Likewise 32K PIAFS, 64K consists of inband negotiation and ARQ transmission control procedure.)
- ③ It should have high future scalability.
- ④ Modification points for 64K PIAFS

According to above-mentioned consideration points, 64K PIAFS is realized by having clock speed twice faster than 32K PIAFS. Also constants specified by time are doubled. Followings are major modified points.

- Consecutive number of times of synchronization reject (L) : 20 times (32K) → 40 times (64K)
- Number of consecutive transmission of data link release reception (k) : 20 times (32K) → 40 times (64K)
- Number of times of continuous FCS error (EFmax) : 20 times (32K) → 40 times (64K)

64K PIAFS Configuration Technology

■ Cell Station (CS)

CS hardware requirements for 64K data communication are to map two arbitrary slots into one BCH by following specified mapping rule, and to allocate 2 slots simultaneously to one PS communication. Currently among DoCoMo Cell Stations, 64K data communication is supported by public CS, indoor concentrating CS (RCU), PHS interface unit (PIU) to

connect PBX and PHS network. However to connect with 64K data communication via PIU, it requires PBX side also supports 64K data communication.

There are some old type equipments, which do not support 64K data communication. By the way 64K data communication uses radio resource twice more than 32K data communication. So to maintain communication quality it is necessary to set up more radio channels per area than before. With these reasons, we have developed multi channel CS with multiple radio equipment (6ch, 7ch) to provide 64K data communication service.

■ Personal Station (PS)

- (1) Radio circuit control

- ① CS search

When PS detects 64K data communication supporting data card connection, it starts to search CS that supports 64K data communication. It takes 4.8 seconds maximum to search 64K data communication supporting CS since it checks available slots included 2nd system information broadcasting sent from 64K data communication supporting CS.

- ② Origination process

When PS receives 64K origination request from back end equipment, it requests 2 slots of 32K communication slot to CS and established 64K channel.

- ③ Termination process

When PS back end is connected with 64K data communication supporting data card, it responses 64K termination. And it establishes 64K channel by using two 32K communication slots. PHS can't identify difference

between data communication (32K/64K) and voice at the time of call termination. So first PS responds to the termination and after receiving call set up information, it confirms whether call can be terminated or not. Then if call termination is not possible, PS breaks the link.

(2) Data card interface

① Control serial

Control between PS and data cards is performed by serial signal with 2,400bit/s unique format.

② Provision of communication clock

PS provides 32K or 64K clock to adapter before sending communication serial signal to data card after call connection.

③ Transiting data onto slots

PS transits 64K data signal sent from data card to 2 slots of 32K-communication slot of radio section. Also it transits data from 2 slots of 32K-communication slot to 64K data channel and sends them to data card.

Conclusion

This article described the outline of PHS 64K data communication system. We are going to improve data communication environment by giving consideration for user demands and Internet market.