

Hybrid Products Combining PDC and PHS “Doccimo” and “Mobile Card Duo”

Sales of “Doccimo”, a hybrid product of Cellular phone (PDC) and PHS, started on April 19, 1999. It was developed from a concept of combining superior features of both PDC and PHS into one unit.

This paper describes the product concepts and techniques of “Doccimo” and “Mobile Card Duo” which is a data card which can be connected with “Doccimo”.

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Preface

Each Cellular phone (PDC) and PHS has its own feature. Merits of PDC are; ① Wide service area, ② High connection quality, and ③ Accessibility when moving at high-speed.

On the other hand, merits of PHS are; ① Reasonable charge, ② Clear speech quality, ③ High speed data communication, ④ Accessibility in subterranean area and ⑤ Utilization as a cordless phone at home or offices. “Doccimo” combined these merits of both PDC and PHS into one unit.

Namely, it can be said that “Doccimo” features three points as follows; ① Cost saving, ② Multi-use and ③ Area free.

Three Features of the Hybrid Mobile Phone

■ Cost Saving

PHS is usually cheaper when you make a call to a fixed telephone or to a PHS comparing call charges between PDC and PHS, but PDC is cheaper when you make a call to a PDC.

“Doccimo” has a function that users can easily switch a calling mode depending on the destination of their calls, so that users can reduce their charges.

Although each of the basic charge for PDC and PHS is required, the amount will not be a simple sum of these basic charges if services such as “Family Discount”, “Business Discount”, “One Year Discount” or “Long Term Subscriber Discount” are offered.

For heavy users therefore, they can be rewarded for cost

reduction as a whole because increased basic charge will be less than total discount charge.

■ Multi-use

Functions and services of PDC and PHS are available by one “Doccimo”. One of the major functions is high-speed data communication (32K/64K) by PHS. A service of 32K data communication started in April 1997 has greatly contributed to the increase in the number of wireless data communication users along with the spread of note type PCs and Internet (Figure 1).

Furthermore, DoCoMo's 64K data communication service launched at full-scale in April 1999 is the first service in the industry which conforms to PIAFS (PHS Internet Access Forum Standard) Ver.2.0, and more popularization is expected from now on.

Another major function is that it is compatible with each mail of PDC/PHS. Users will be able to have reliable communication with more partners by selecting various mail services such as PDC's “Short Mail” and “10 Yen Mail” and PHS's “Chara Mail” and “Chara Talk” according to type of his/her partner.

Furthermore, Voice Mail Service and Call Forwarding Service are also available.

A card that corresponds to PDC/PHS data communication of “Doccimo” is called “Mobile Card Duo”. One card can handle 9600 data/fax communication in PDC and 64K/32K data communication in PHS. The data communications connected with the existing PDC (Digital mova) and PHS (PALDIO) are also possible.

■ Area-free

On the basis of PDC's wide service area, a clear communi-

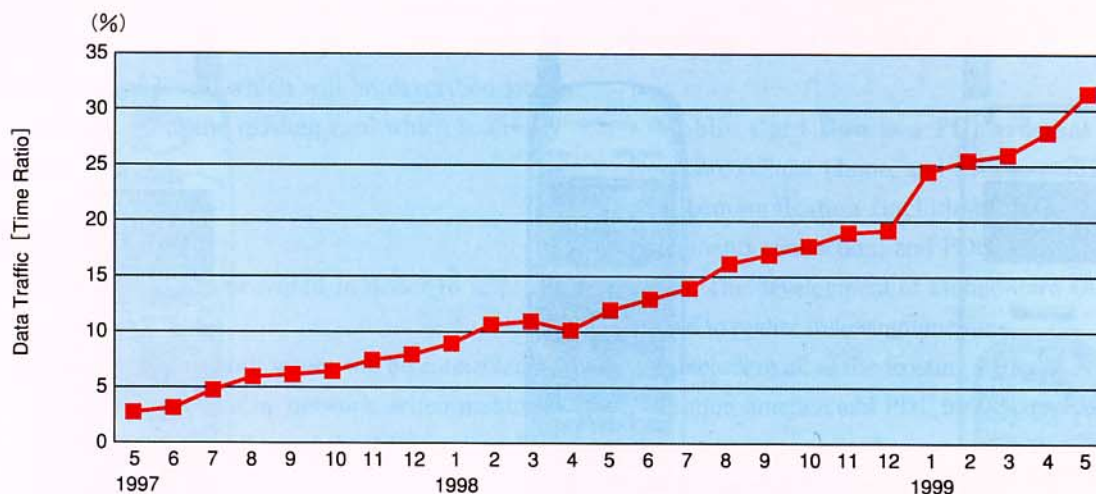


Figure 1 Transition of Data Traffic in the Entire PHS Communication

Table 1 Specifications of “Doccimo” PDC/PHS Mobile Phone

Item	SH811	N811	P811
Communication System	PDC (800M) / PHS	PDC (800M) / PHS	PDC (800M) / PHS
Weight / Volume	Approx. 86g / Approx. 86cc	Approx. 86g / Approx. 89cc	Approx. 83g / Approx. 84cc
Size	Approx. 127mm×41mm×22mm	Approx. 132mm×40mm×21mm	Approx. 127mm×39mm×20mm
Call Time (PDC)	Approx. 100 minutes	Approx. 110 minutes	Approx. 120 minutes
Call Time (PHS)	Approx. 8 hours	Approx. 7 hours	Approx. 7 hours
Standby Time (PDC)	Approx. 200 hours	Approx. 270 hours	Approx. 280 hours
Standby Time (PHS)	Approx. 650 hours	Approx. 650 hours	Approx. 540 hours
Standby Time (PDC/PHS)	Approx. 180 hours	Approx. 210 hours	—
Screen Display	6 characters×3 lines	9 characters×3 lines	8 characters×3 lines
Memory Dial	2 numbers×250 records	3 numbers×100 records+400 records	500 records
Indoor Mode	Available	—	Available

cation quality is realized by using PHS mode in urban areas. Also, PDC mode secures communications even when moving at high-speed. Moreover, the PHS mode allows accesses to subways and subterranean areas, which means the service area becomes wider compared with the one of either PDC or PHS.

Type SH811 and P811 can be used at home or in office as cordless phone, the available areas of one “Doccimo” will extend remarkably compared with a single unit of the existing PDC, PHS, or cordless phone.

Doccimo

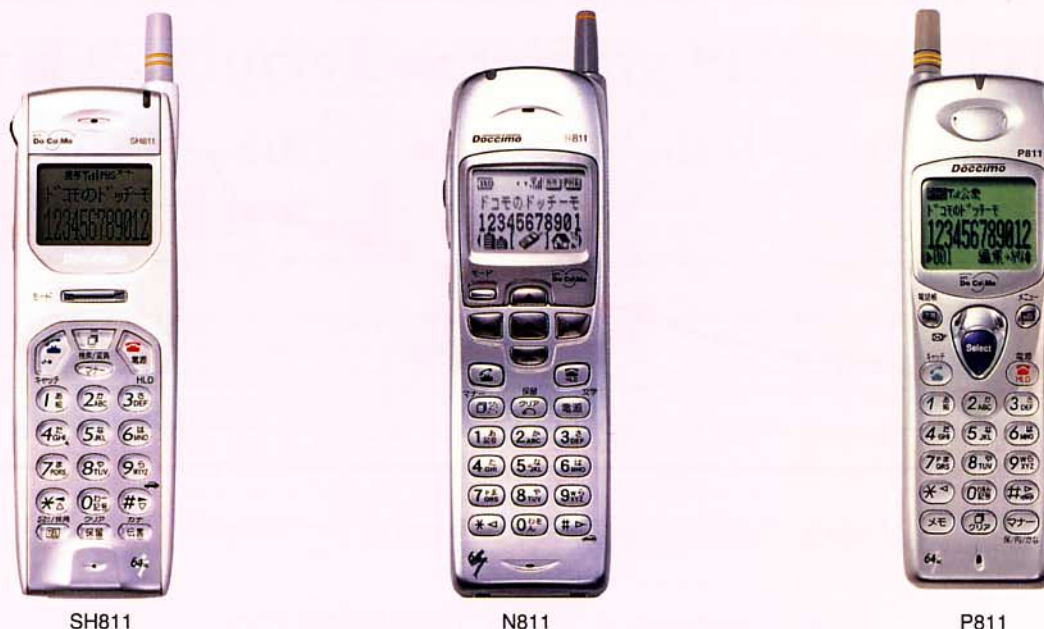
Doccimo contains two radio parts; “PDC 800M” specified in RCR STD-27 and “PHS” specified in RCR STD-28. It is a “PDC/PHS Integral Hybrid Mobile Phone in One Body” controlled by one man-machine interface. The major param-

eters are listed in Table 1 and the appearances are shown in Picture 1.

■ Standby

Doccimo has two types of standby modes; one can be on standby for both PDC and PHS at the same time, while another has to switch the mode each by each, as shown in Table 1. In the case of PDC/PHS standby, we have a merit of receiving both calls. However, we will have a demerit instead which makes the standby time, the life of mobile phone, shorter due to an increase of standby current.

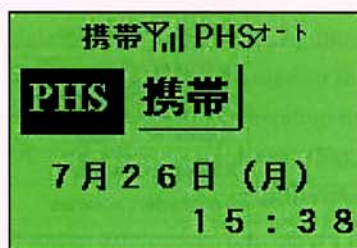
Although the mobile phone in a standby mode of either PDC or PHS can only receive a call of the either one, it can practically receive both PDC and PHS calls by combining a network Call Forwarding service. It is profitable compared with PDC/PHS Standby mode because only one of reception parts has to be turned on.



Picture 1 "Doccimo" PDC/PHS Mobile Phones



(1) Indoor
(HS1, PHS and PDC : In Service Area)



(2) Outdoor
(HS1 : Out of Service Area,
PHS and PDC : In Service Area)



(3) Outdoor
(HS1 and PHS : Out of Service Area,
PDC : In Service Area)

Condition
In case it is registered in Home Station (Digital Cordless Master Phone)
The Priority other for ongoing : ①HS1, ②PHS, ③PDC

Figure 2 Examples of Display in Standby Mode

■ Display

Although the amount of contents to be displayed on the screen has increased due to the unification of PDC and PHS, the display is easy to understand for users. Figure 2 illustrates examples of displays in standby mode. In these examples, the mobile phone is registered as an extension of Home Station (a master phone of cordless phones) and is set in PDC/PHS standby mode. The priority order for ongoing destination shall be; ① Home Station, ② PHS and ③ PDC.

The display example (1) shows all three modes are in service area and connection destinations are displayed in the order of priority from left to right, and the ongoing destination is displayed by reversed figure. Example (2) is the case

of outdoor. PHS/PDC are displayed because the Home Station is out of service area. In case PHS is out of service area and only PDC is in service area, the display is given as example (3).

■ Data Communication

All types of Doccimo support 64K/32K data communication (PHS) and 9600 Data/Fax communication (PDC). Therefore, high-speed data communication can be provided during in stationary or when moving at low-speed, and a comfortable data communication for e-mails can be provided when moving at high-speed. We expect this will be a bridge for the full-scale mobile multimedia in IMT-2000.

The optimal data communication is now possible at any time and anywhere with one card and one mobile phone by using "Mobile Card Duo" which will be described later, together with supporting the existing card which is already on the market.

■ Operability

Following functions are provided in order to improve users' operability.

- A user can select a network where will be connected to, besides the current standby network, when making a call from Doccimo regardless of the PDC and/or PHS standby mode.
- A user can select an ongoing network by pressing buttons such as "Mode" and "Select" before pressing "Start" button after inputting a telephone number.
- When a user performs data communication, the mobile phone judges automatically whether a connected card is for PDC or for PHS, and then switches over in the mode of the connected card regardless of the current standby mode.

We have considered that users can enjoy these functions without any stress by making the best use of the merit of the integral hybrid mobile phone.

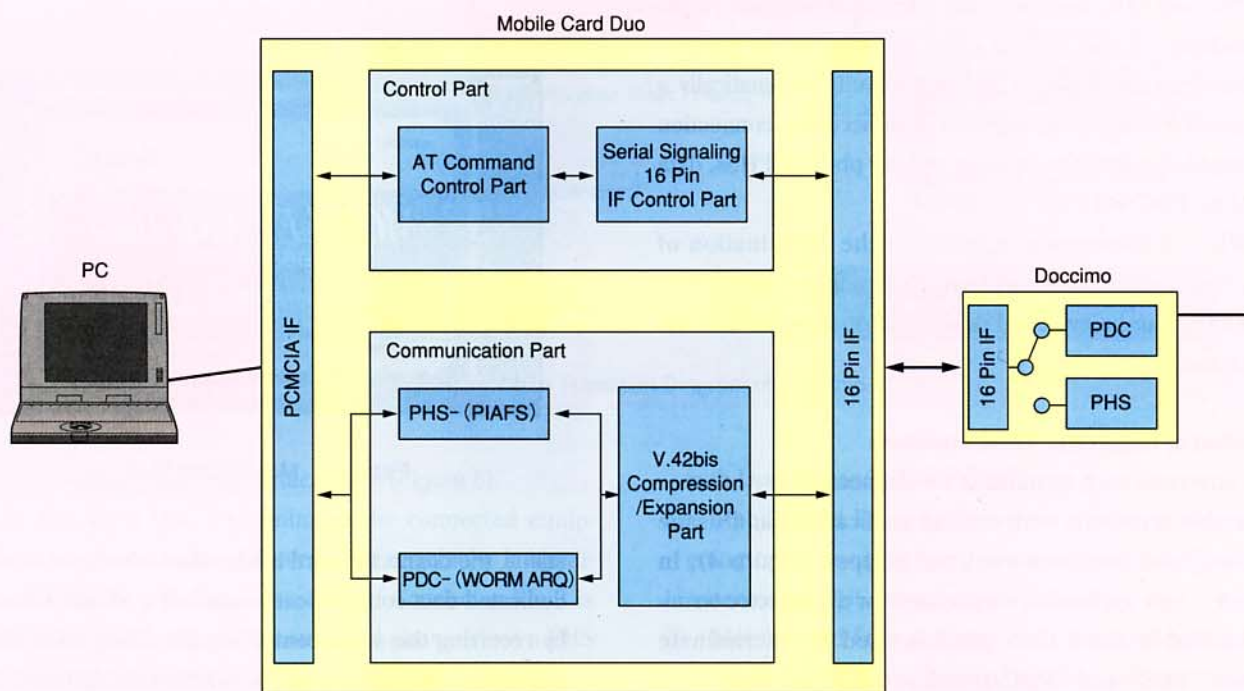
Mobile Card Duo

Mobile Card Duo is a PC card that connects with Doccimo, cellular phone, and PHS to realize PHS 64K/32K data communication (including PTE (Protocol Transfer Equipment) connection) and PDC 9600 Data/Fax communication. The development of Mobile Card Duo has been conducted to realize following functions.

- ① Including all of the existing PHS 64K/32K data communication function and PDC 9600 Data/Fax communication function into one card.
- ② Being able to connect with Doccimo, the existing cellular phone and PHS and identifying automatically the connected phone.
- ③ When Mobile Card Duo connects with Doccimo, a user can switch each system of PDC and PHS optionally (It can be set by AT commands).

Just only one Mobile Card Duo is needed to connect with the existing PHS and PDC by having both PHS 64K/32K data communication function part and circuit switching 9600 Data/Fax communication part (Figure 3).

In this case, the connected phone is identified automatically by a well-contrived interface connecting the card and the phone, a user therefore can use his/her phone without rec-



PIAFS : PHS Internet Access Forum Standard

Figure 3 Configuration of Mobile Card Duo

ognizing the type of the connected phone.

As one of the functions of communication mode switching when Doccimo is connected, we realized a function that specifies a radio system by AT commands at ongoing. We also realized a function that switches a radio system depending on the situation from PHS64K to PHS32K, from PHS32K to PDC 9600 or, from PDC 9600 to PHS, etc. When a user cannot use PHS because he/she is out of the service area, he/she can make a call by switching the mode automatically into the PDC 9600 mode, which brings the user a stressless mobile data communication.

The specifications and appearance of the Mobile Card Duo is shown in Table 2 and Picture 2.

Hybrid Mobile Phone Interface

On the development of Doccimo and Mobile Card Duo, they have to be connect with the existing PHS/PDC products. In order to improve user availability when connecting with the existing products and using Doccimo and Mobile Card Duo, one of the most important points to take into consideration was an interface part between the phone and the card.

The interface part is explained below.

■ Features

- ① PHS and PDC interfaces are integrated into one 16 pin connector.
- ② Doccimo and Mobile Card Duo identify automatically a connected equipment, together with securing connection compatibility with the existing cellular phones, PHSs, data card for PDC/PHS.
- ③ When a connection is made on the combination of Doccimo and Mobile Card Duo, each radio system of PHS and PDC can be switched depending on the user's ongoing request.

■ Method to Implement These Functions

- (1) Converting each terminal of the connector

Sharable terminals with similar applications and usage purposes have been extracted and mapped (Figure 4). In addition, a new application was defined for a connector terminal (In Mobile Card Duo, pin 3 is used to discriminate between "PHS" and "PDC/Doccimo").

- (2) Automatic identification method

- ① Just after Doccimo is turned on, the serial control signaling rate of the 16 pin interface is set at 600 bit/s. In this

Table 2 Specifications of Mobile Card Duo

Item	Content
Applicable Network	PHS network Digital cellular/car phone network (PDC)
DTE Interface	PC Card Standard Type II (68 pin)
DTE Speed	2400, 4800, 9600, 19200, 38400, 57600, 115200bit/s
DTE Software Interface	In conformity to Hayes AT Command
PDC/PHS Interface	Control serial : 2400bit/s, 600bit/s Communication serial : 64kbit/s, 32kbit/s, 9600kbit/s (16pin)
Communication Speed	PHS 64K data communication : 58.4kbit/s PHS 32K data communication : 29.2kbit/s PDC 9600 data communication : 9600bit/s
Radio Section Error Control System	PHS data communication : PIAFS PDC 9600 data/fax communication : WORM-ARQ
Radio Section Data Compression/Expansion	V.42bis
Power Supply	DC5V±0.5V (supplied from PC card slot)
Power Consumption	Approx. 100mW
Outer Dimension	85.6 (W)×54.0 (D)×5.0 (H) mm (PC Card Standard Type II)
Weight	Approx. 30g
Applicable Models	Doccimo, Digital mova, PALDIO
Accessories	Card connection cable N1 for cellular phone / Doccimo Card connection cable N1 for PALDIO



Picture 2 Mobile Card Duo

status, the connected card is identified whether it is a PDC dedicated data communication card or a Mobile Card Duo by receiving the serial control signals "Non voice service request" . The serial speed is switched to 2400 bit/s if the identification signal is not received in this stage, then it identifies whether the connected card is a PHS dedicated card or not according to the existence of the serial control

Pin No.	PHS Connector Signaling Name	Pin No.	PHS Connector Signaling Name
1	Uplink Digital Signals	1	Ground for Serial Signals
2	GND	2	Transmission Voice / TCH Transmission Signals
3	Reserved	3	Ground for Transmission / Reception Signals
4	Downlink Frame Clock Signals	4	TCH Frame
5	Bit Clock	5	TCH Clock
6	Serial Signals for Uplink Control	6	Uplink Serial Signals
7	Serial Signals for Downlink Control	7	Downlink Serial Signals
8	Signals for Maintenance	8	Reserved
9	GND	9	Ground for Serial Signals
10	Downlink Digital Signals	10	Reception Voice / TCH Reception Signals
11	Adapter Wake up Signals	11	Reserved
12	CRC Error Output Signals	12	Cellular Phone Operation Part Control Signal 1
13	Uplink Frame Clock Signals	13	Cellular Phone Operation Part Control Signal 2
14	Adapter Detection Signals	14	Unit Existence
15	PS Wake up Signals	15	Unit Power Supply Control
16	Signals for Maintenance	16	Reserved

Figure 4 Mapping Table of PHS, PDC Phone's External Interface Pin Assignment

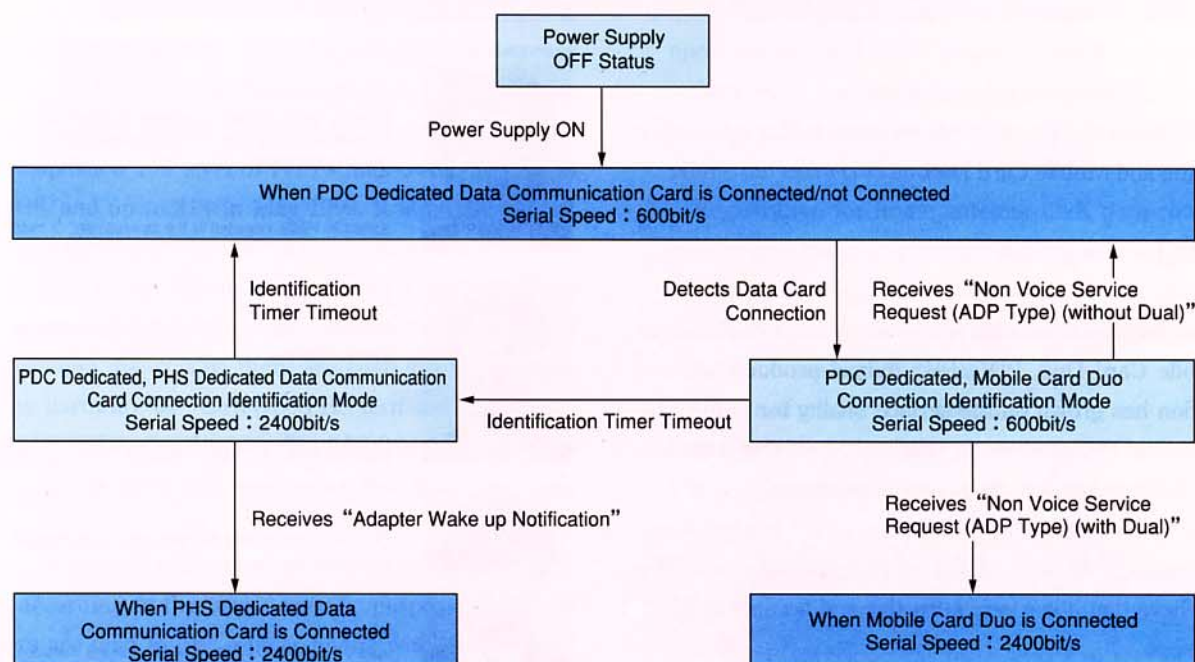


Figure 5 State Transition Diagram of Doccimo

signal "Adapter wake up notification" (Figure 5).

- ② Mobile Card Duo discriminates the connected equipment using electric level detection of terminals. It identifies the connected phone as a PHS if Connector Pin 3 is OPEN. It identifies that the connected phone is not a PHS if Connector Pin 3 is GND, then identifies whether it is a PDC or a Doccimo according to the serial control signal "Non telephone service confirmation" (Figure 6).
- ③ Switchover between PHS and PDC when connecting

with Doccimo and Mobile Card Duo

- ① Mobile Card Duo can determine a radio system that is going to be used by using the serial control signals that specifies the PHS mode or the PDC mode.
 - ② Mobile Card Duo confirms each status of in/out of-service-area for PDC and PHS in Doccimo, and can determine the communication method.
- Communication is performed by switching each terminal function of the connector into the radio system determined

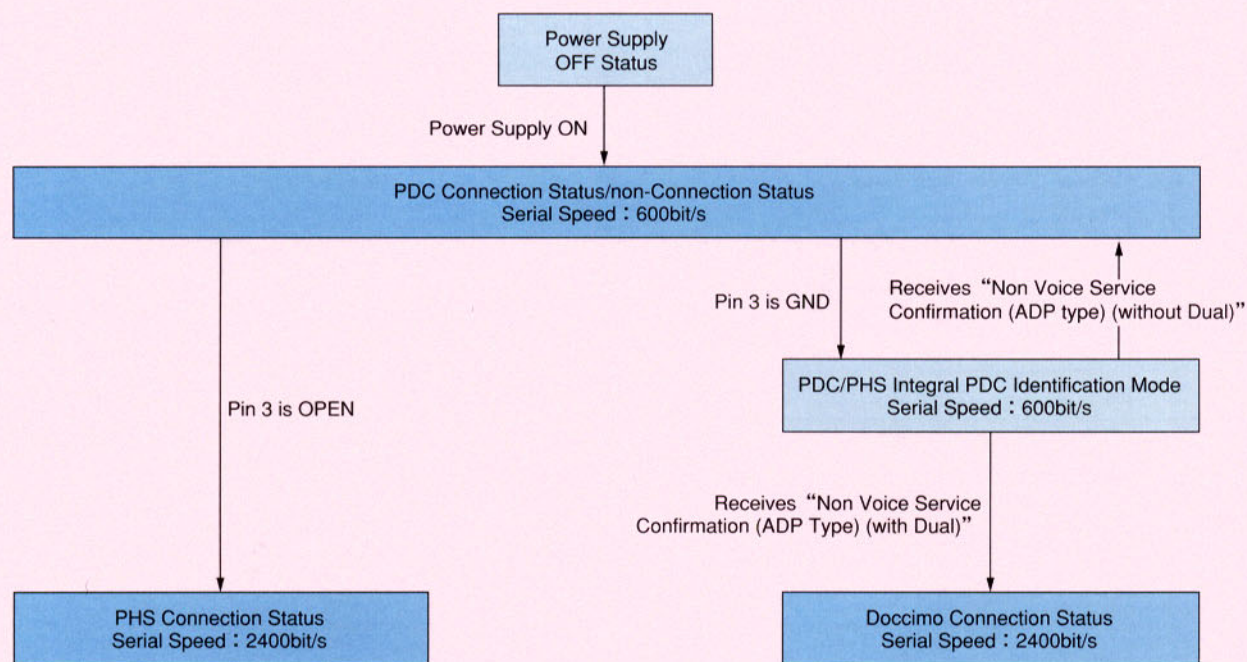


Figure 6 State Transition Diagram of Mobile Card Duo

by either of the methods mentioned above.

Application of this interface allows users better operability of Doccimo and Mobile Card Duo.

Closing

This paper described the products concept of Doccimo and Mobile Card Duo, PDC/PHS hybrid products. As the competition has grown on the service quality for both cellular phones and PHSs, advertisements to appeal this point has been the mainstream for other companies recently.

On the other hand, Doccimo is a product of combining every advantage of both PDC and PHS into one unit. We firmly believe that it is a very attractive and acceptable product for users.

Reference

- [1] Kaneda et al : "Interface between PDC/PHS Hybrid Mobile Phone and PDC/PHS Hybrid Data Card" , Institute of Electronics, Information and Communication Engineers, Proceeding from Communication Society Meeting 1999, (B-5-125), September 1999.