Special Article on Advanced i-mode Mobile Phones

Implementing an External Interface

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For i-mode mobile phones, we developed an interface to external devices so that users can use the i-mode equipped i-mode Car Navigation Systems and other external devices by connecting them with the mobile phones. We also developed object exchange applications, including phonebook exchange. This article reviews the external interface of i-mode mobile phones.

New Technology Report

1. Introduction

i-mode mobile phones enable users to exchange e-mails and access Web sites with the mobile phones alone, without relying on PCs or Personal Digital Assistants (PDA). Owing to such convenient features, subscribers to the i-mode Service are skyrocketing in number, and at the same time, the number of contents designed for i-mode are dramatically increasing. As a result, there is an emerging need to enable users to access these contents from external devices connected with i-mode mobile phones. This article describes the interface for enabling this function.

This article also discusses the development of object exchange applications, such as phonebook exchange. As mobile phones are becoming increasingly advanced in function, they have started take up the roles of PCs and PDAs for information management, including phonebook, e-mail and scheduling functions. We will therefore review the means that make easy data exchange possible between a mobile phone and a PC, and between two mobile phones.

2. External Interface of i-mode Mobile Phones

2.1 TL External Interface

(1) Protocol

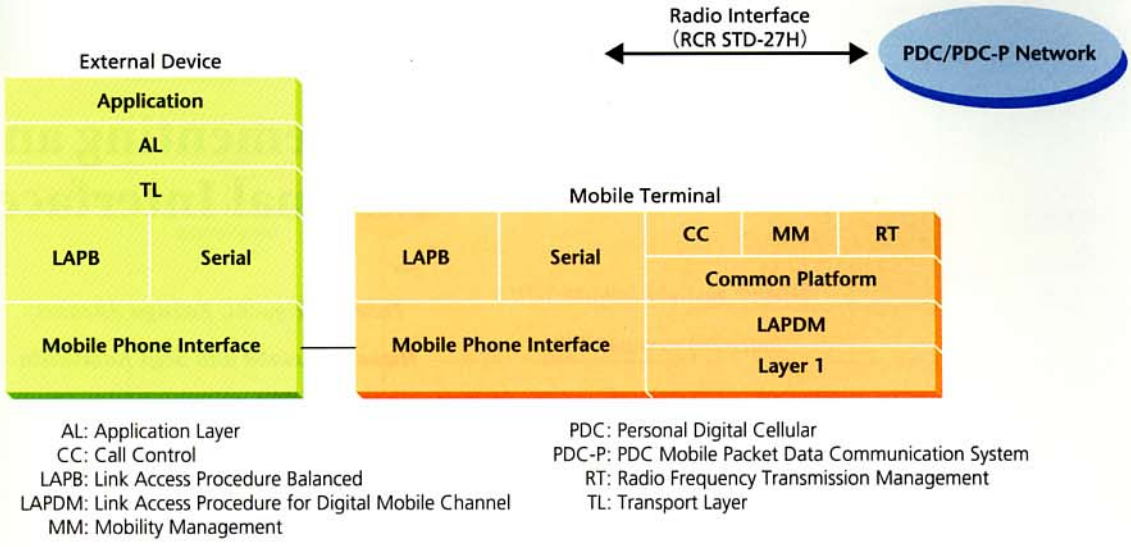


Figure 1 Protocol Stack

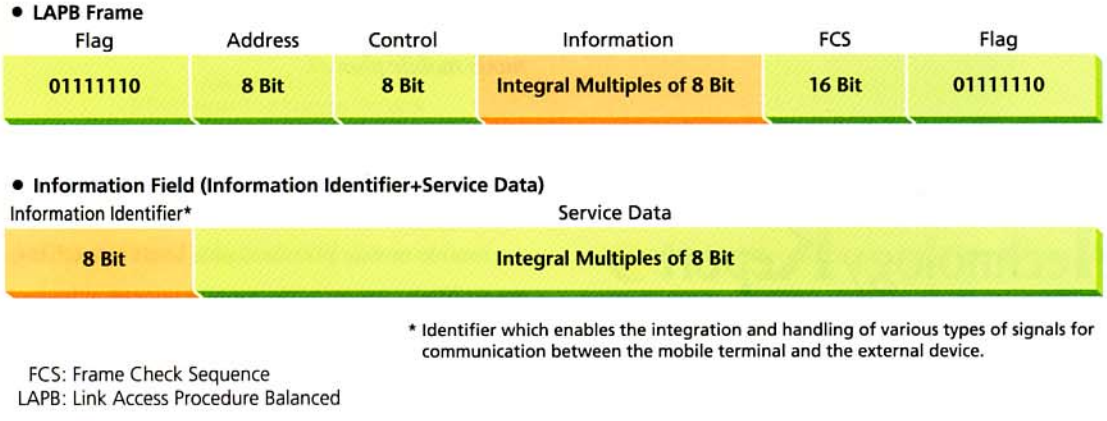


Figure 2 LAPB Frame Configuration

Figure 1 illustrates the protocol stack of an external device connected with a mobile phone, and the protocol stack of two mobile phones. As shown in the protocol stack of Figure 1, mobile phones are concerned with protocols in layer 3 and lower. The division of layer 3 makes the protocol stack on the mobile terminal side essentially the same as DoPa.★1

(2) Signal Transmission System

For controlling, serial signals are used between the external device and the mobile phone. For data transmission between the external device and the mobile phone, the Link Access Procedure Balanced (LAPB) protocol is used for transmitting data in the Transport Layer (TL) by LAPB frames. The LAPB protocol was chosen for the following reasons.

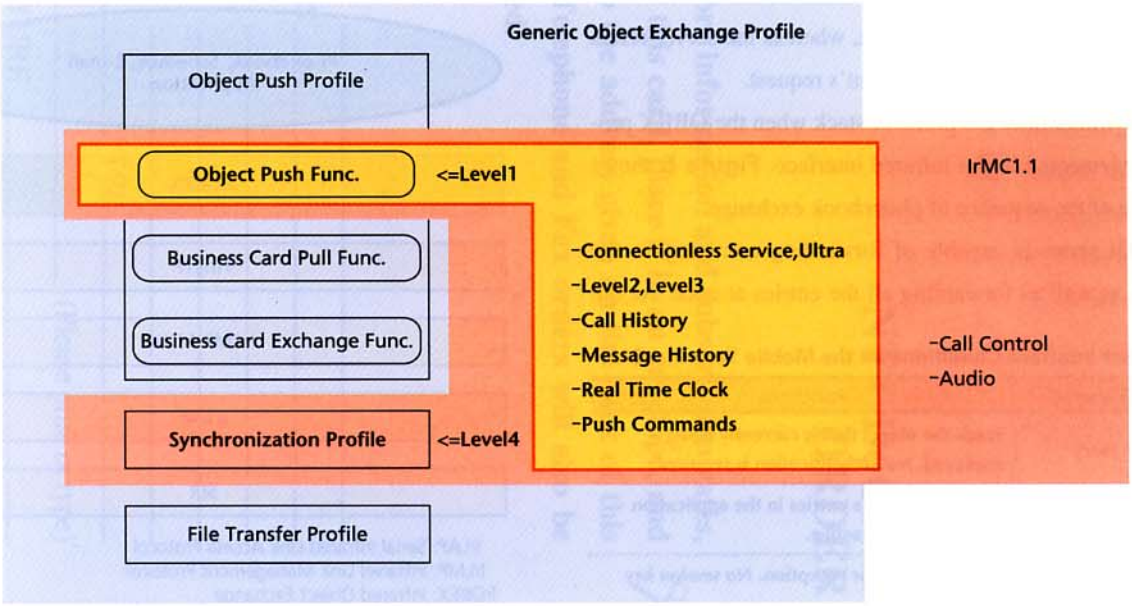
- The interface assumed Car Navigation Systems as the external device to be connected with mobile phones. A highly efficient and reliable transmission control protocol (data link layer protocol) was therefore required, to cope with the large impact of noise from the vehicle due to the longer cable length in comparison to data communications by PCs.
- As LAPB had already been implemented successfully in the DoPa interface, it allowed the efficient use of existing resources for mobile terminals.

Figure 2 shows the configuration of LAPB frames.

(3) Security

Conventionally, in i-mode, the security of content was protected by completely terminating the service at the i-mode mobile phone. Allowing external devices to access the i-mode service endangers content security. Hence, a system to check the authenticity of external devices from mobile phones and a system to enable the content provider to distinguish access from external devices were introduced, so that the availability of the

★1 DoPa: A packet communications service, which connects data terminals to networks of the PDC Mobile Packet Data Communication System (PDC-P), and enables users to access the Internet, corporate LANs and other external networks by PPP.



IrMC: Infrared Mobile Communication

Figure 3 Infrared Communications Interface

i-mode service is limited to external devices with the same security level as i-mode mobile terminals.

2.2 Infrared Communication Interface [1]–[5]

The external interface of a mobile phone can be used, for example, to exchange personal data with PCs, such as memory dialing data. However, most conventional interfaces, which use 16-pin or 18-pin connectors, are user-unfriendly in the sense it requires the users to establish physical connection with PCs by serial cable, etc. Even infrared rays, which are used by some mobile phones for personal data exchange, are unsatisfactory as the format and the protocol differs from mobile phone model to mobile phone model, which leaves the incompatibility problem between models unsolved.

To solve these problems, the 503i series recommends the use of infrared, Bluetooth and other wireless interfaces for personal data exchange, and specifies a standardized protocol and a data format in detail. This article focuses on technologies that use infrared.

(1) Overview of Infrared Communications Interface

The shaded areas in **Figure 3** are the parts specified in detail for the 503i series. Functions specified by the Infrared Mobile Communication (IrMC)[★2] include the exchange of objects (e.g., phonebook, schedule), data communications (e.g., Internet access) and the transmission of speech data. This article covers specifications for the exchange of phonebooks, schedules and other objects.

(2) Characteristics of Infrared Communications

The characteristics of infrared communications are as described below.

① Merits of Infrared Communications

- There are no legal restrictions against infrared communications. Infrared can be used worldwide.
- High Security: Infrared rays are blocked by walls, and cannot leak outside buildings.
- Small, lightweight and inexpensive hardware.
- Infrared causes very little Electromagnetic Interference (EMI).

② Demerits of Infrared Communications

- Requires an unobstructed line of sight between the transmitter and the receiver.
- Unsuitable for long-distance communications.
- Easily affected by light (noise).

(3) User Interface Conditions on the Mobile Terminal Side

Table 1 shows the user interface conditions required by the mobile terminal for object exchange.

(4) Object Exchange Protocol (OBEX)

OBEX is a protocol in the session layer, for exchanging objects between devices as described in (5). It has a similar configuration to the Hyper Text Transfer Protocol (HTTP). In addition to infrared, OBEX can be used for physical interfaces like Bluetooth and the Universal Serial Bus (USB).

In OBEX, a client-server relationship is always formed

★2 IrMC: A data exchange protocol based on infrared communication standard IrDA1.0/1.1.

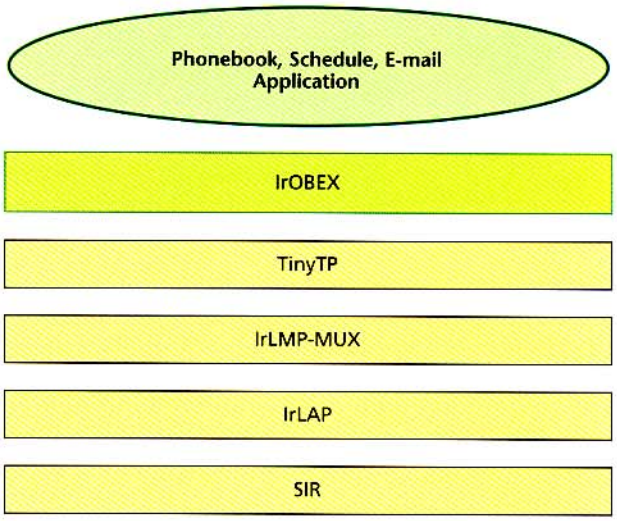
between devices. The client in OBEX refers to the device transmitting a request for object exchange, whereas the server refers to the device that responds to the client's request.

Figure 4 illustrates the protocol stack when the OBEX protocol is implemented in the infrared interface. **Figure 5** shows the example of the sequence of phonebook exchange.

The 503i series is capable of forwarding one entry in the phonebook as well as forwarding all the entries at once. As the

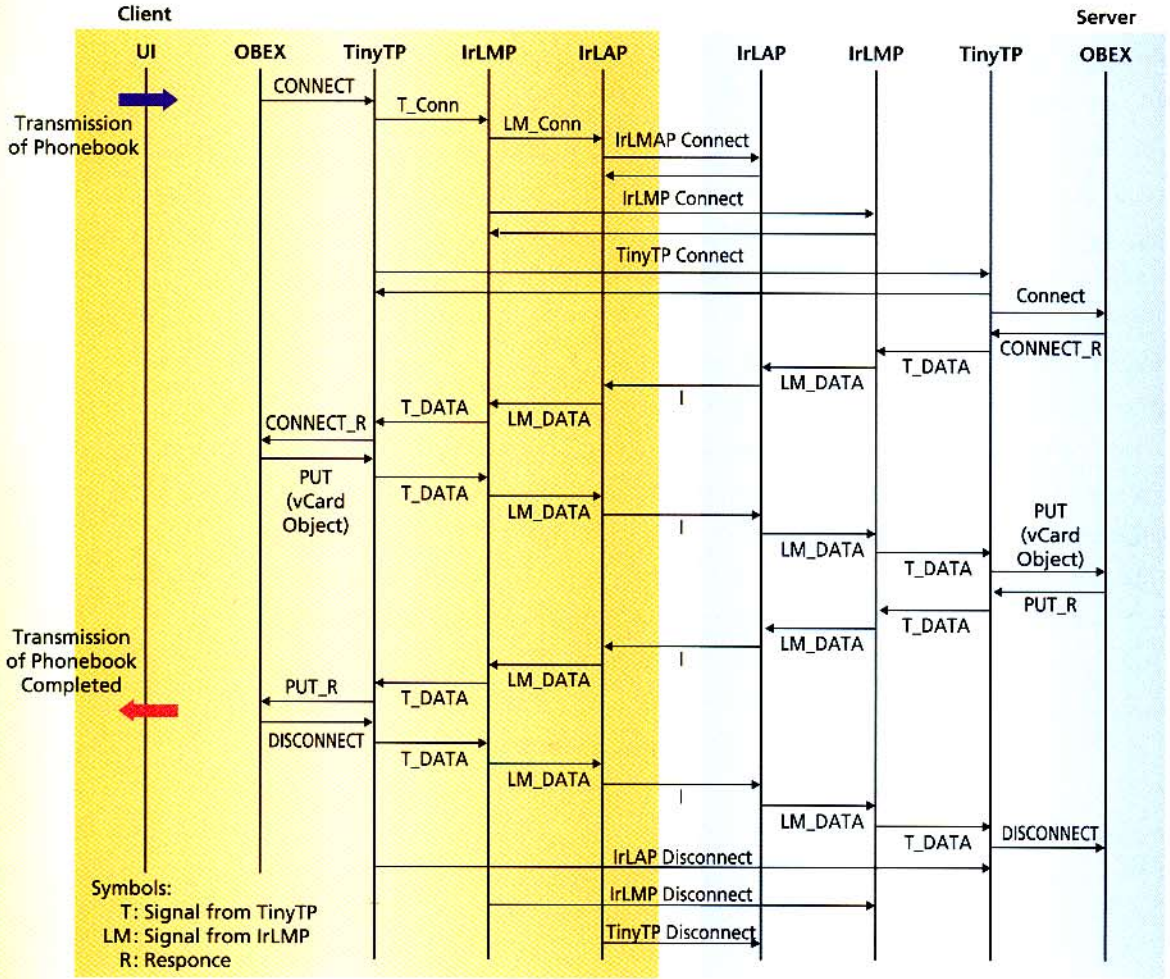
Table 1 User Interface Conditions on the Mobile Terminal Side

Name (Example)	Functions
Send 1 Entry	Sends the object that is currently being displayed. No authentication is required.
Send All Entries	Sends all the data entries in the application that is currently active.
Reception Standby	Standby mode for reception. No session key entry is required.
Reception Standby (Authentication Required)	Standby mode for reception. Object exchange that requires authentication.



IrLAP: Serial Infrared Link Access Protocol
IrLMP: Infrared Link Management Protocol
IrOBEX: Infrared Object Exchange
MUX: Multiplexer
SIR: Serial Infrared

Figure 4 Protocol Stack (When the OBEX Protocol is Implemented)



IrLAP: Serial Infrared Link Access Protocol
IrLMP: Infrared Link Management Protocol
OBEX: Object Exchange Protocol
UI: User Interface

Figure 5 Phonebook Forwarding Sequence by Infrared Communications

phonebook consists of personal information, the 503i requires the user to enter a password before forwarding all the entries at once. The user is authenticated by password as follows.

① On both client and server sides, the user must enter the password into his/her mobile phone.

② For confirming the connection between the client and the server, the user must enter a 4-digit number that is common to both sides. (This four-digit number is referred to as "session key".)

③ The user on the client side operates the mobile phone to execute transmission. All the entries in the phonebook will be forwarded only if the user is successfully authenticated by password entry.

Figure 6 illustrates the key stages in this process.

(5) Object Format

The term "object" refers to private information, including phonebooks, schedule and memos. As the object format, IrMC and other protocols specify open standards like vCard (phonebook), vCalendar (schedule) and vMessage (message), some of which have already been adopted by PCs and PDAs.

In conventional PDC mobile phones, the memory dial data format was specified so that it can be forwarded via a serial interface, with a 16-pin connector. This data format, which was exclusive to PDC mobile phones, offered no data compatibility with PCs, PDAs or other peripheral devices.

Hence, the 503i series recommends data forwarding by the OBEX protocol mentioned in (4), based on vCard, vCalendar and vMessage, which are standard formats slated to be adopted by mobile phones in compliance with the International Mobile Telecommunicaitons-2000 (IMT-2000). (503i also supports the existing memory dial data format, in order to ensure compatibility with the conventional PDC mobile phones.)

There are four support levels of object exchange, from Level 1 to Level 4, as described below. The nature of support provided at each level is as follows.

- Level 1 (Minimum Level)

  Provides the means for the client to send a single object to the server.

- Level 2 (Access Level)

  Provides the means for the client to exchange all the objects in a specific object domain at once, as an object stream.

- Level 3 (Index Level)

  Specifies each object by the Index, and exchanges just the objects that need to be exchanged.

- Level 4 (Synchronization Level)

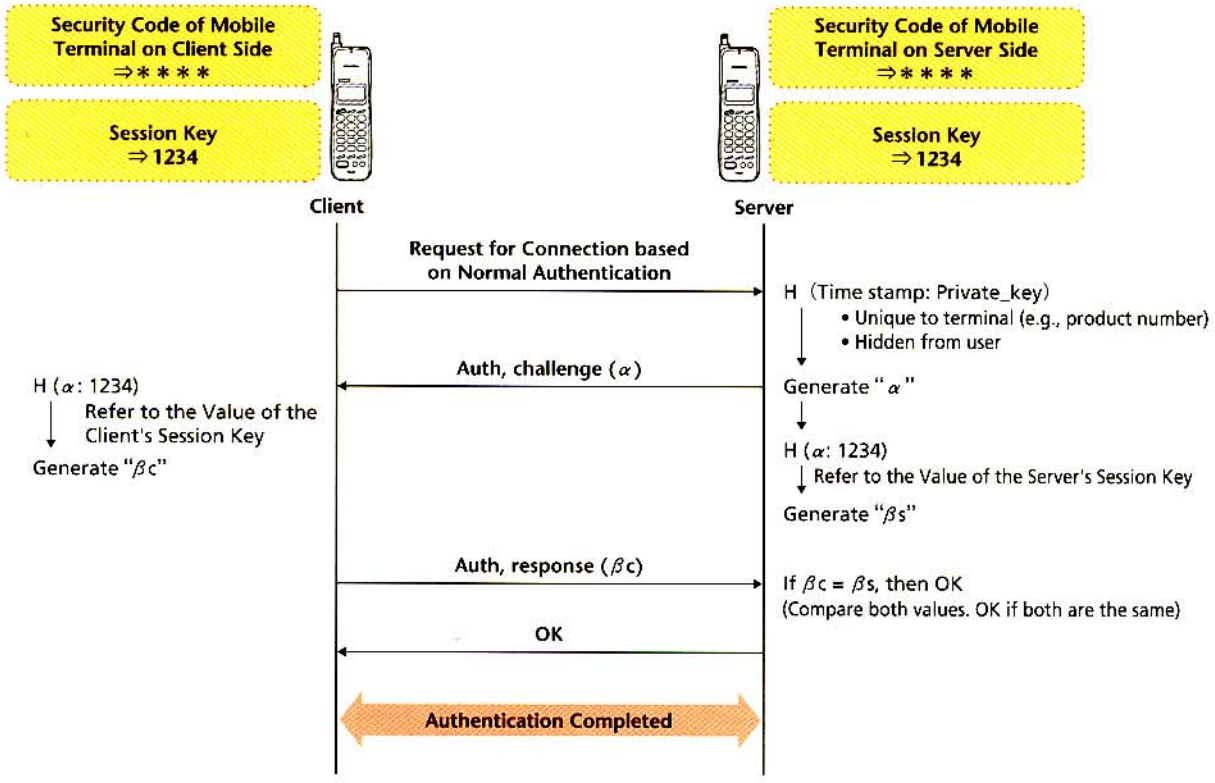


Figure 6 Authentication Flow

```
BEGIN:VCARD
VERSION:2.1
N;CHARSET=SHIFT_JIS:携帯;花子;;;          ← Name
SOUND;X-IRMC-N; CHARSET=SHIFT_JIS:ケイタイ;ハナコ;;; ← Reading
TEL;VOICE:090123456789                    ← Phone Number
EMAIL:                                    ← E-mail Address
X-CLASS:PUBLIC                            ← Secret Attribute
X-GNO:1                                   ← Group Number
X-GN:                                     ← Group Name
X-REDUCTION:                              ← Memory Dial
END:VCARD
```

Figure 7 Example of a Phonebook Object

Refers to the update log for each object, and synchronizes (matches/coordinates) the object between the client and the server.

The 503i series supports up to Level 2 for phonebook exchange.

Figure 7 illustrates an example of a phonebook object.

In the 503i series, essential information in the phonebook includes the name, the furigana (phonetic transcription), the phone number, the e-mail address and the secret attribute.

3. Conclusion

The progress in various types of devices around mobile phones has been just as dramatic as the evolution of mobile phones themselves. New services are expected to emerge and grow, with a wide range of peripheral devices in connection with mobile phones, as well as mobile phones connected with each other. We will continue developing external interfaces for mobile phones to enable their connection with various types of devices as such.

GLOSSARY

AL: Application Layer
CC: Call Control
EMI: Electromagnetic Interference
FCS: Frame Check Sequence
HTTP: Hyper Text Transfer Protocol
IMT-2000: International Mobile Telecommunications-2000
IrLAP: Serial Infrared Link Access Protocol
IrLMP: Infrared Link Management Protocol
IrMC: Infrared Mobile Communication
IrOBEX: Infrared Object Exchange
LAPB: Link Access Procedure Balanced
LAPDM: Link Access Procedure for Digital Mobile Channel
MM: Mobility Management
MUX: Multiplexer
OBEX: Object Exchange Protocol
PDA: Personal Digital Assistant
PDC: Personal Digital Cellular
PDC-P: PDC Mobile Packet Data Communication System
RT: Radio Frequency Transmission Management
SIR: Serial Infrared
TL: Transport Layer
UI: User Interface
USB: Universal Serial Bus

REFERENCES

[1] IrMC version 1.1 (Specification for Ir Mobile Communications, version 1.1, Infrared Data Association)
[2] IrOBEX version 1.2 (IrDA Object Excange Protocol, version 1.2, Infrared Data Association)
[3] vCard version 2.1 (The Electronic Business Card Version 2.1, A versit Consortium)
[4] vCalendar version 1.0 (The Electronic Calendaring and Scheduling Exchange Format Version 1.0, A versit Consortium)
[5] K.Nagata et al: Application of Infrared Communications Technologies in Mobile Communication Terminals, New Technology Report Japanese Version, Vol.6, No.1, pp.23-27, Apr.1998.