

Special Articles on Services for Next-Generation Smartphones

i-mode Services for Smartphones (i-concier/Data Security Service)

The mobile terminal market in Japan is currently transitioning from feature phones to smartphones. For NTT DOCOMO, this is resulting in a need to enhance its lineup of services for smartphones using sp-mode. Some services, including i-melody and Melody Call, are already available through sp-mode, and now the i-concier and Data Security services are being added. These services mirror existing i-mode functionality, and provide extended functionality for smartphones. As a result, we have been able to migrate services quickly, gaining a foothold in developing NTT DOCOMO's superior services for the smartphone market.

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1. Introduction

NTT DOCOMO has developed many original services supporting and enriching the lifestyles and activities of i-mode subscribers. By also developing many services for sp-mode, we aim to realize a smart life, personalized to each individual [1]. The first step in achieving this is to migrate the i-concier and Data Security services on i-mode to sp-mode. These services need to be migrated quickly in response to the remarkable spread of smartphones in

recent years. However, there are differences between i-mode and sp-mode, in terminal specifications, system structure and content being provided, so there were technical issues in providing i-mode services on sp-mode as-is. To provide these services quickly and at low cost, we reused existing mechanisms, protocols and data formats. Also, by developing new data handover and conversion methods, we were able to implement seamless service migration. We have also implemented improved functionality, utilizing the

features of smartphones, by developing new User Interfaces (UI) and methods for handling higher-volume content, and linking applications.

In this article, we give an overview of the i-concier and Data Security services migrated to sp-mode and describe various aspects of the servers.

2. Server Extensions

For i-mode, the i-concier and Data Security services are provided by the treasure Casket of i-mode service, high Reliability platform for CUSomer

(CiRCUS)^{*1}. For sp-mode, we continue to use the existing CiRCUS functionality, and have achieved the service migration by implementing a new sp-mode GateWay (GW) and linking with the Multi-Access Platform System (MAPS)^{*2}. An overview of service provision is shown in **Figure 1**.

2.1 i-concier Service

The i-concier service provides lifestyle support to users with notification functions (hereinafter referred to as “Information”) and an automatic update function for i-Schedule and ToruCa^{*3}.

1) Information

Information comprises various

types, such as train operations information or regional events. To have users notified according to their lifestyle, the Information they receive can be customized in their profile. This configuration data is managed together on CiRCUS for both i-mode and sp-mode, so settings can be handed over between i-mode and sp-mode when there is a contract change Service Order (SO). This eliminates the need for the user to reconfigure, and Information personalized to each user can be delivered immediately after migration. Also, by using the CiRCUS Information delivery function, the same types of information can be provided with sp-mode as is pro-

vided with i-mode. We also extended functionality to distinguish the information content distributed to feature phones (i-mode terminals) and smartphones (i-mode terminals) and smartphones by referencing subscriber information when it is distributed.

We are providing i-concier as a trial service, delivering Information free-of-charge for 30 days, but this can only be used once. To promote the service on sp-mode as well, we also enabled use of the trial service on sp-mode, even if users have used the trial service on i-mode.

Among the various types of Information, some is delivered for free and some is for a fee, so free delivery in

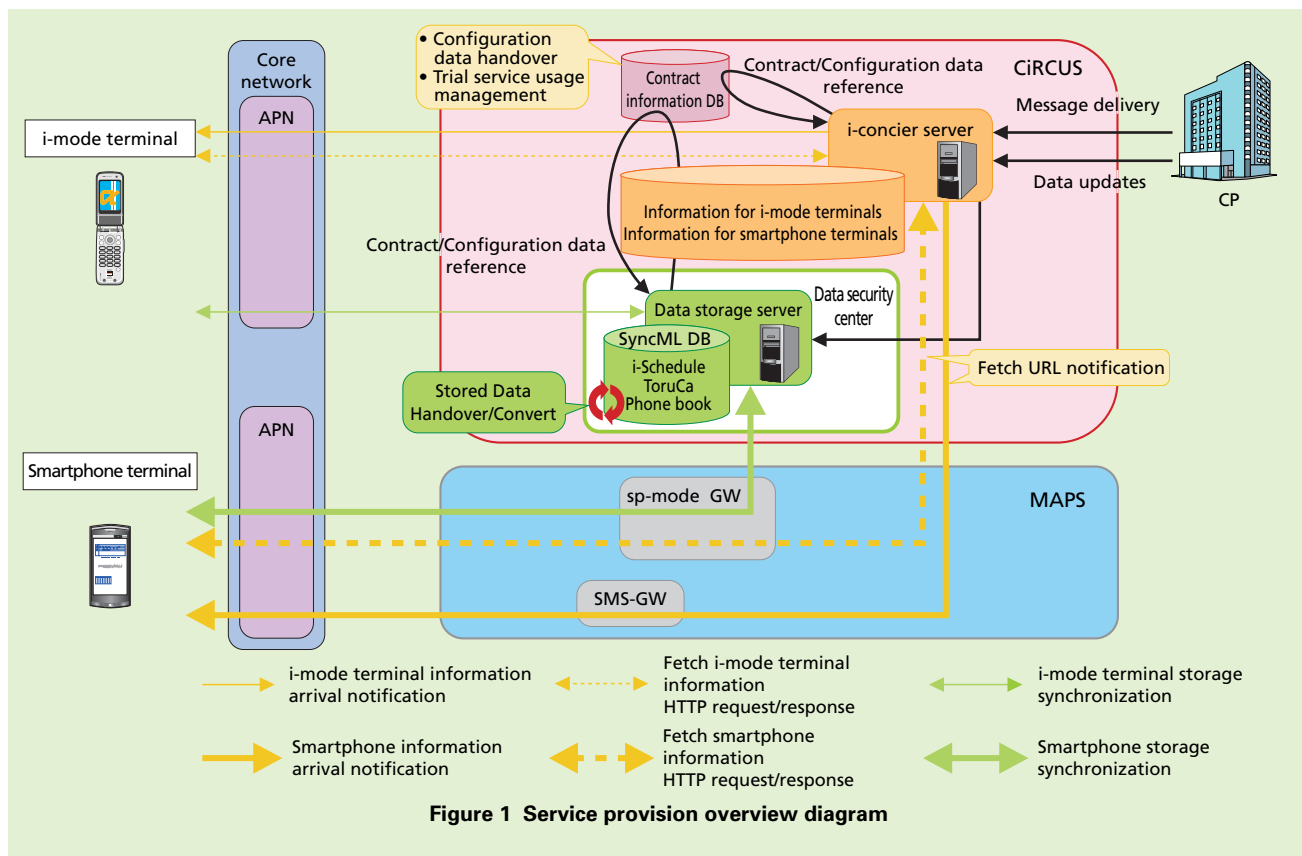


Figure 1 Service provision overview diagram

*1 **CiRCUS**: A device that serves as an interface between the NTT DOCOMO core network and the Internet, provides i-mode mail, i-mode menu, ordinary Internet access and other functions.
 *2 **MAPS**: A platform providing Internet and

business-system connections from FOMA, “Xi” (Crossy) and other access circuits.
 *3 **ToruCa**: A service that can incorporate such cards as restaurant cards and coupons traditionally distributed at shops in paper media format into mobile terminals.

sp-mode was an issue. To implement free delivery with i-mode, the charging-class is specified in the HTTP^{*4} response when retrieving information. In contrast, with sp-mode, fees are determined by the IP address^{*5} in the request URL^{*6} configured in the HTTP request when retrieving information, so the request URL must be configured according to the charging class of the information being used. However, the terminal application cannot determine the charging class of information stored on the server, so it cannot determine the URL to retrieve the information. Thus, to realize free-of-charge delivery on sp-mode we implemented a mechanism on the i-concier server to notify the

terminal application of the request URL to retrieve the Information, in the SMS^{*7} or HTTP response. This enabled us to implement the migration without degradation of the services [2].

2) Automatic update of i-Schedule and ToruCa

This function supports the user's activities by automatically updating i-Schedule and ToruCa data that the user has synchronized with the data security center, always providing them with the latest information. The content provided by Content Providers (CPs) is different on i-mode and sp-mode, so when a contract changes, the user must download content again and synchronize it with the data security center.

Accordingly, we also developed a mechanism to automatically convert content IDs between i-mode and sp-mode when there is a contract change SO. The content conversion mechanism is shown in **Figure 2**.

- When a CP begins providing content for sp-mode, to support automatic ID conversion for the content, it registers the ID conversion on CiRCUS (Fig. 2(1)).
- When there is a contract change SO (Fig. 2(2)), if ID conversion is configured for content being synchronized with the data security center, the ID is automatically converted (Fig. 2(3)).
- The content is then synchronized

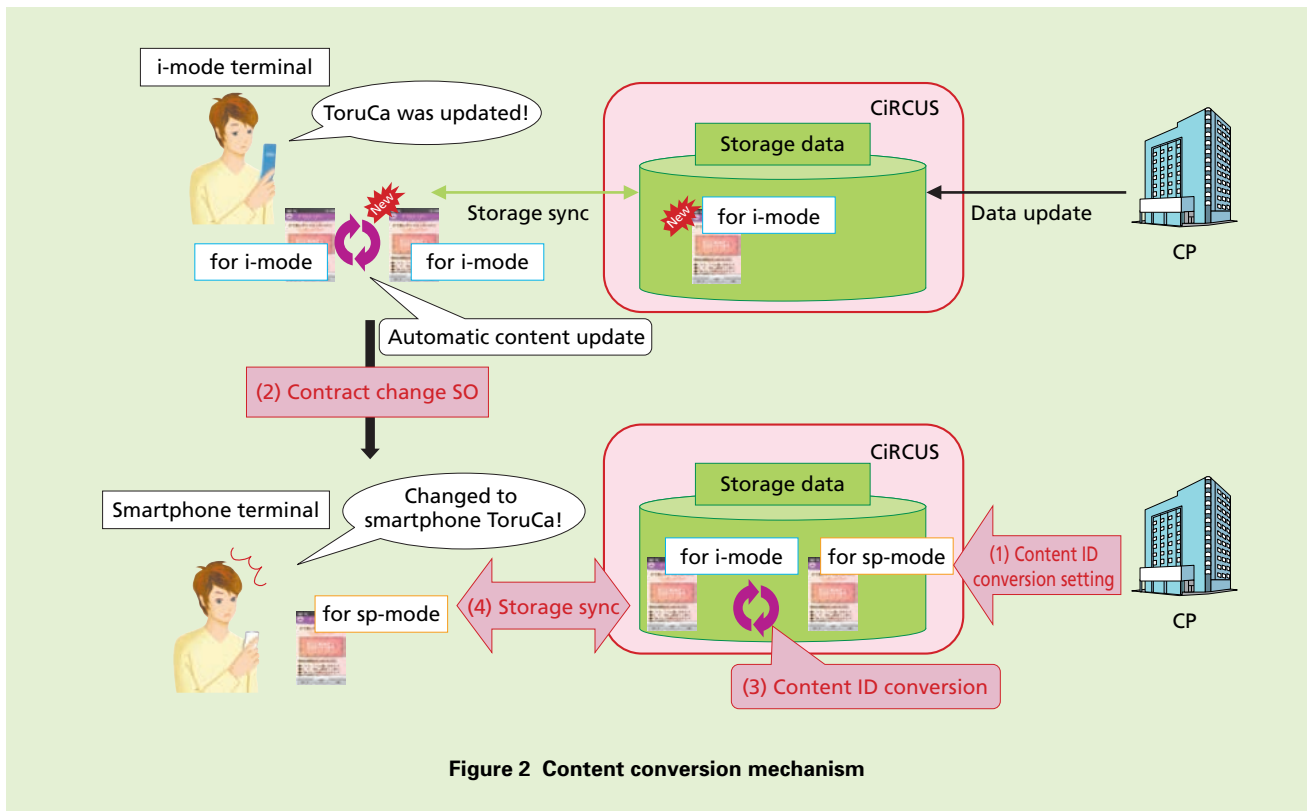


Figure 2 Content conversion mechanism

*4 **HTTP**: A communications protocol used between Web browsers and Web servers to send and receive HyperText Markup Language (HTML) and other content.
 *5 **IP Address**: A unique identification number allocated to each computer or communications

device connected to an IP network such as an intranet or the Internet.
 *6 **URL**: Uniform Resource Locator. A method describing the location of information resources (documents, images, etc.) on the Internet.

*7 **SMS**: A service for transmitting/receiving short text-based messages. SMS is also used for transmitting/receiving mobile terminal control signals.

with terminal applications using the existing automatic update function (Fig. 2(4)).

This allows the latest information to be provided to the terminal being used by the user, and realizes seamless service migration.

2.2 Data Security Service

1) Synchronization Protocol and Data Formats

Data synchronization for the sp-mode Data Security Service (hereinafter referred to as “sp-mode Data Security”) uses the Synchronization Markup Language (SyncML)^{*8} protocol, conforming to Open Mobile Alliance (OMA)^{*9} standards. This is the same as is used for the i-mode Data Security Service (hereinafter referred to as “i-mode Data Security”) and the existing sp-mode phonebook backup function.

Similarly, we have adopted vFormat^{*10} data formats, inheriting know-how from developing i-mode Data Security and the sp-mode phonebook backup function, and enabling sp-mode Data Security to be provided quickly and at low cost[2].

2) Data Handover Scheme

For sp-mode Data Security, we implemented seamless service migration by developing a reciprocal data migration (handover) function for i-mode Data Security and sp-mode Data Security data stored on the data

security center. This data migration is performed (including a confirmation from the end user) when there is a contract change SO between i-mode Data Security and sp-mode Data Security. As part of this, phonebook data items are converted using a data-item mapping managed on the security center, because there are differences between the data items on i-mode and sp-mode terminals. Text is also converted between Shift-JIS^{*11} (i-mode) and UTF-8^{*12} (sp-mode) encoding.

3) Support for Data Expansion

For sp-mode Data Security, the size of ToruCa that can be stored is larger, at a maximum of 500 KB compared to 100 KB for i-mode. ToruCa for i-mode and sp-mode are stored on a common DataBase (DB), and there has been concern about performance for users storing large numbers of high-volume ToruCa when referencing ToruCa data from smartphone applications. Thus, rather than expanding all ToruCa data in memory as was done in the past, we use a method whereby we only expand the keys we will be referencing in memory, and later, when a key is needed, we retrieve the required ToruCa data from the DB. This has allowed us to improve the functionality for smartphones handling high-volume content.

Also, the smartphone phonebook stored in sp-mode Data Security has more property items than the i-mode phonebook. When storing phonebook

data in the data security center, we control the disk capacity needed by encoding the phonebook property item-values^{*13}, enabling us to provide the service at reduced cost. When synchronizing phonebook data or referencing it from an application on a smartphone terminal, we designed the system to convert the coded property item-values back to their original form to avoid affecting the interfaces between terminals and servers (Figure 3).

3. Application Improvements

3.1 i-concier Application

The i-concier application is linked to various other NTT DOCOMO Android^{TM*14} applications (Machi-chara^{*15}, Phonebook, Schedule&Memo, ToruCa, DOCOMO Backup and AUTO-GPS, etc.), and implements the i-concier service provided on i-mode terminals. With this implementation, we made the following functional improvements.

1) Smartphone Implementation of Information Reception

For the Information service, as with i-mode terminals, to implement a real-time information delivery service update notifications are sent to the terminal through SMS in order to receive the information. Information can also be received through Wi-Fi^{*16} when connected by Wi-Fi, after authentication with user data. If information is received while the screen of another application is being displayed, or the

*8 **SyncML**: Specifications for synchronization of data between mobile terminals or between a mobile terminal and a PC.

*9 **OMA**: An industry standardization organization that aims to standardize service and application technology and achieve interoperability

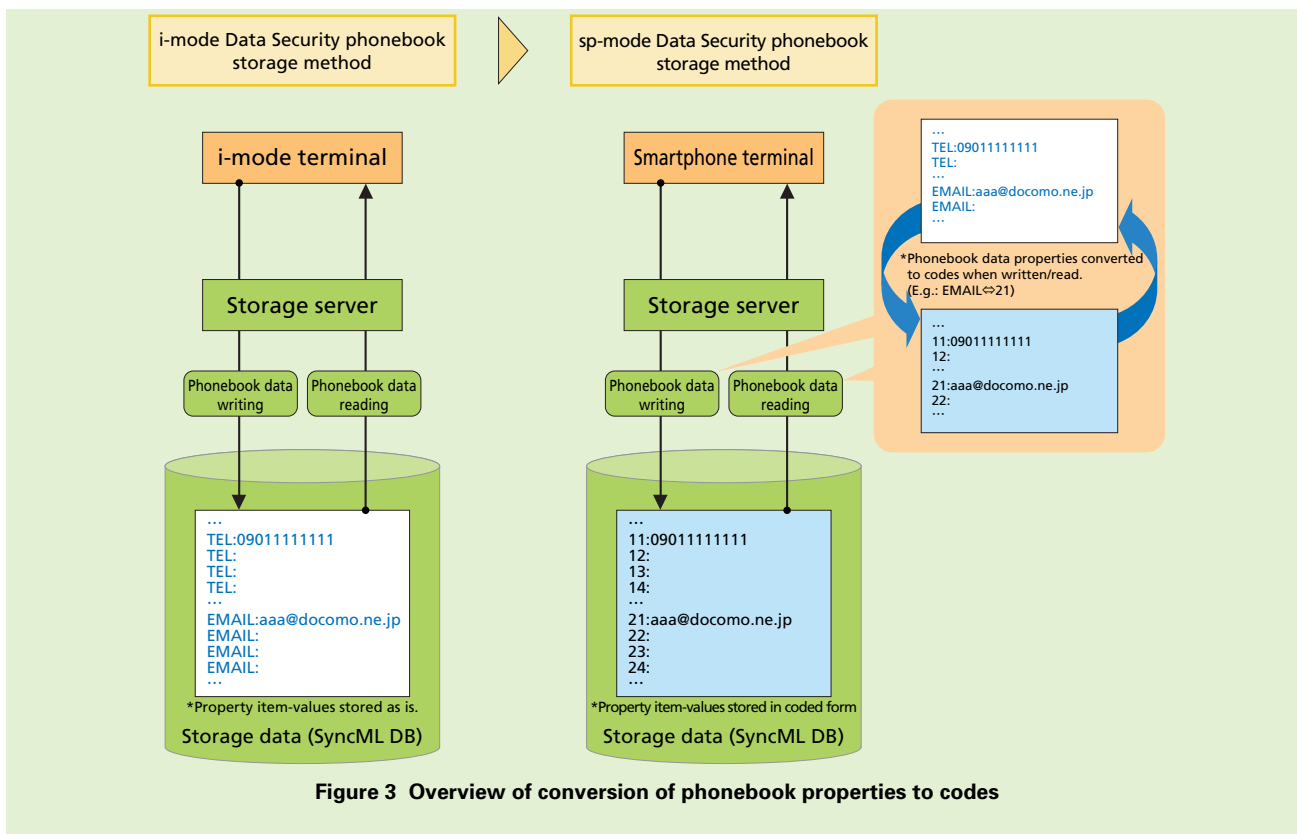
in mobile communications.

*10 **vFormat**: A generic name for formats such as vCard, which is a standard format for business cards, and vNote, which is a standard storage format for mobile terminal notebook data.

*11 **Shift-JIS**: One type of Japanese language

character code set. Used as standard with i-mode terminals.

*12 **UTF-8**: A multi-lingual character code that is used on the Android platform.



screen is locked, it is displayed in the notification area (Figure 4 (1)). The number of unread items is also displayed over the application icon and on the top screen of i-concier, making it more visible to the user than ever before (Fig. 4 (3) to (5)).

2) Usability Improvements Using Smartphone Characteristics

To create a graphical display taking usability into consideration, we implemented a screen UI with smartphone features. We describe three such features below.

- Machi-chara application widgets^{*17}
To allow the user to check details of the information even

when the i-concier application is not running, the Machi-chara application was implemented using Android widgets. As a result, the Machi-chara and pop-up display areas are preserved on the home screen, and can be displayed at all times without being hidden by other items such as icons (Fig. 4 (2)).

- Information detail screen application
With i-mode terminals, the detailed information screen for each Information item and any later screens were displayed in the browser, but the UI and any screens before the detailed information

screen was not consistent. To resolve this, we developed an i-concier content application for displaying detailed information, and implemented a detailed information display for each type of Information. This was done as a separate application from i-concier, enabling us to develop it quickly.

- Settings screen application
On i-mode terminals, the settings for the i-concier service were also displayed in the browser, but to avoid the trouble of launching the browser each time settings were adjusted, we developed a mechanism to implement a settings screen

*13 **Property item value:** Elements comprising vCard, the standard business card format, such as “Name (N)” and “Telephone number (TEL)”.

*14 **Android™:** A software platform for smartphones and tablets consisting of an operating

system, middleware and major applications. A trademark or registered trademark of Google Inc., United States.

*15 **Machi-chara:** A service that displays a character that is chosen by the user on the standby screen or menu screen of a mobile terminal.

*16 **Wi-Fi®:** A registered trademark of the Wi-Fi Alliance.

When receiving information	(1) Display in notification area (2) Display in Machi-chara application
Display of unread information	(3) Unread items over application icon (4) Unread items on i-concier top screen (5) Unread item marks for each information item



*This is provided only in Japanese at present.

Figure 4 i-concier application overview

UI in the i-concier application. Specifically, it retrieves the current settings from the server and performs changes and updates to the settings from the i-concier application. Note that the screen layouts for the i-concier application are described in HTML, so other settings screens can reuse the screen layouts.

3.2 Schedule and Memo Applications

To implement the i-concier service on smartphones, we developed a Schedule & Memo application (hereinafter referred to as “Schedule&Memo”) with functionality to support user activities and display information available to i-concier service subscribers.

1) Extending Data from the Standard Calendar Application

An overview of data extensions for the standard calendar application is shown in **Figure 5**. The Android platform has a standard calendar application for handling schedule data (hereinafter referred to as “the Standard Calendar”), and this data can be synchronized with Google™¹⁸ servers. However, implementing the i-concier service requires support for various original i-mode properties not provided by the Standard Calendar, such as properties for i-Schedule (a data format for managing associations among multiple schedules such as movies, sports matches or artist activities), and for adding helpful lifestyle information from the server. To support these prop-

erties in Schedule&Memo, we created an extended DB, besides the standard calendar DB, within the application. We store the i-Schedule data and original properties in this extended DB. Access to the extended DB is restricted to protect i-Schedule data among other reasons.

By using two different DBs, we are able to handle both data that can be synchronized with Google servers and data that can be synchronized with the data security center at the same time. To maintain consistency between the two DBs when referencing or updating data, we maintain links to the Standard Calendar DB within the extended DB for each item in the extended DB.

Also, providing this extended DB enabled us to handle other data within

*17 **Widget**: A generic term for a simple function described by application software, displayed on a PC’s desktop screen or a smartphone’s home screen and executed in a specific runtime environment. Also called “gadget” or “desktop tool.” Widgets have been expanded for use on

mobile terminals.

*18 **Google™**: A trademark or registered trademark of Google Inc., United States.

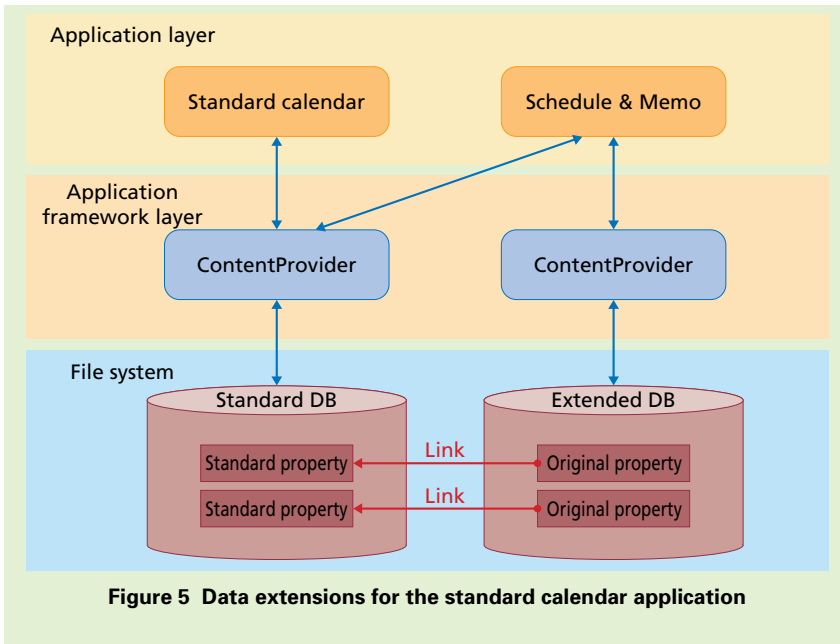


Figure 5 Data extensions for the standard calendar application

Schedule&Memo that cannot be registered in the standard calendar DB because it does not have a start date and time value, such as a ToDo list and text memos. Handling it this way, reduces the changes required in Schedule&Memo when the OS is updated, because we do not need to update our own standard calendar.

2) Migrating i-mode Functions Using Android Platform Features

- Using data maintained by other applications

When a user registers a birthday in his/her phonebook, there is an update notification from the phonebook application, and through its link to the phonebook DB, Schedule&Memo automatically displays the birthday on its calendar. It is also possible to place a phone call or send an e-mail from the dis-

played birthday. The i-concier application can also retrieve week-long weather forecasts maintained on the server and display them on the calendar.

- Linking from other applications

Using interfaces for sharing data from sp-mode e-mail and Gallery with external applications, (1) the subject and body of an email can be automatically set from the title and content fields of a Schedule&Memo item, and (2) image data handled by the Gallery can be automatically attached to a Schedule&Memo item. This makes it very easy to create Schedule&Memo data.

- Using widgets

Functionality such as the month and day calendar displays, and the simple memo-creation UI is provid-

ed using widgets, adding to the ways to use Schedule&Memo.

In these ways, we have used the features of the Android platform, while migrating functions from our feature phones to implement a Schedule&Memo application that enables the i-concier services to be used comfortably on smartphones as well.

3.3 DOCOMO Backup Application

With the smartphone i-concier and Data Security Services, the application that handles data transmission and handover with the data security center is the NTT DOCOMO Backup Application (hereinafter referred to as “the Backup Application”).

The Backup Application handles both the Data Security Service provided for i-mode terminals and the phonebook backup service already being offered for smartphones with sp-mode. Thus, the following points were implemented in order to provide the best possible i-concier/Data Security Service on smartphones.

1) Differentiating Menu Screens

The phonebook backup and Data Security services already being offered by NTT DOCOMO use different synchronization protocols and application menu structures.

The phonebook backup service is based on the One-way sync part of the SyncML protocol, so the menu screen

in the phonebook backup application is structured to clearly separate the data transmission directions, with Backup (terminal→data security center), and Restore (data security center→terminal).

On the other hand, the Data Security service is based on Two-way sync, because the i-concier service is also able to add data. Accordingly, the menu screen displays only one item, “Sync with center”, and does not reflect any sense of the direction of data transmission.

The new backup application implements both menus in one application, and differentiates which menu to display based on the user’s subscription status, as shown in **Figure 6**.

For users that have subscribed to the i-concier/Data Security services, the menu for two-way sync (“Sync with center”) is shown, as with i-mode terminals. For users that have not subscribed, the one-way sync menu (with “Backup” and “Restore” options) as with the earlier Phonebook backup function, is displayed to avoid user confusion.

This differentiation of the menu to display is done by taking the subscriber state on the data security center as the truth, and checking with the data security center through a JavaScript Object Notation (JSON)^{*19} Application Programming Interface (API)^{*20} each time the Backup Application is launched or a synchronization operation is started,

and displaying the appropriate menu. Also, considering that there may be a time lag until the subscription state is updated in the data security center, we have also implemented appropriate corrections even after a sync operation has started, by using Experimental Meta Info (EMI)^{*21} during SyncML protocol communication with the data security center.

2) Linking with Other Applications

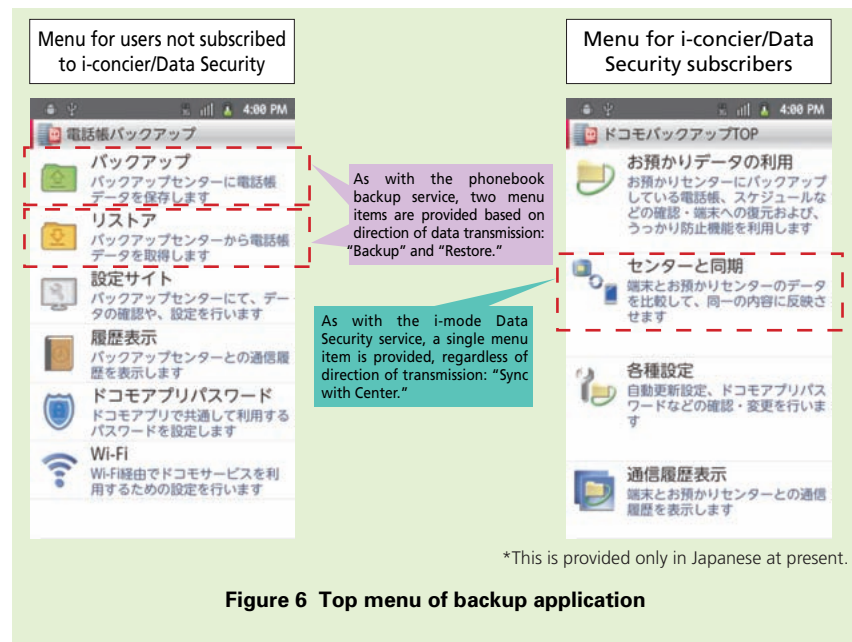
i-concier implements a service able to add and update data for not only the phonebook, but also Schedule&Memo and ToruCa, by synchronizing data with the data security center (server). By using Intents^{*22}, the standard application linking functionality on Android terminals, and ContentProviders^{*23}, a means of data access, we were able to implement synchronization with the data security center for various applica-

tions including the Phonebook, Schedule&Memo and ToruCa, all through the backup application.

3) Implementing a Download Function for Data Unrelated to i-concier

Various types of data from i-mode terminals is stored other-than the phonebook, schedule/memo and ToruCa data related to i-concier function, including images, videos, e-mail, text memos and ToDo data. We have implemented a recovery function assuming that this data will also be used on smart-

phones. For all this data, we use HTTP downloading rather than SyncML. Still images and video are placed in a fixed location on the SD card using a ContentProvider, e-mail is stored in the sp-mode e-mail application DB, and text memos and ToDo items are con-



*This is provided only in Japanese at present.

Figure 6 Top menu of backup application

*19 **JSON**: A data description language based on JavaScript object notation.

*20 **API**: An interface that provides functionality of an application program. Allows developers to develop programs by combining control logic with API calls.

*21 **EMI**: Auxiliary data sent and received using the SyncML protocol.

*22 **Intent**: A mechanism provided by the Android OS for programs to exchange parameters. Used between components within an application and between applications to exchange information.

*23 **ContentProvider**: A mechanism within the Android OS which handles storage and search of data related to general image, audio or video files, personal or other information. Each type of data can be accessed by various applications by using a CP.

verted to Schedule/Memo format and stored in the Schedule/Memo application DB.

4. Conclusion

We have described the structure and function of applications for providing the i-concier and Data Security services on sp-mode. By making it possible to use these services continuously from i-mode, we are promoting the migration

of users to smartphones and increasing the value of NTT DOCOMO services in the smartphone market.

By expanding functionality and developing new services as can only be done with smartphones, we plan to enrich the range of services supporting the individual lifestyles and activities of subscribers and to contribute to providing a full, smart life.

REFERENCES

- [1] S. Irokawa et al.: "Smartphone Services as New Business Platform," NTT DOCOMO Technical Journal, Vol. 14, No.1, pp. 4-7, Jul. 2012.
- [2] H. Suzuki et al.: "Application Functions for Autumn/Winter 2008 Models (1) i-concier and One-step User Memory Back-up Functions," NTT DOCOMO Technical Journal, Vol. 10, No. 4, pp. 45-50, Mar. 2009.