

## Mobile Terminal Software Platform OPP

*Recent years have seen changes in the mobile phone market together with intensified competition, and this has led to calls for the development of a mobile terminal software platform for the more efficient and rapid creation of NTT DOCOMO services. Consequently, from 2008 NTT DOCOMO developed an OPP to be used as a software platform, and this has been implemented on winter/spring 2009, and on summer 2010 model mobile terminals. The introduction of this new software platform has streamlined the development of new mobile terminals and promoted a wider variety of terminals and increased globalization.*

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### 1. Introduction

In recent years, the pursuit of further enhanced functionality and services, as well as increased ease-of-use for consumers in order to respond to the increasingly intensified competition in the mobile phone market has resulted in ever-increasing functionality and complexity in mobile terminal software. Given this, NTT DOCOMO has developed the Mobile-phone Oriented Application Platform (MOAP)<sup>\*1</sup> middleware<sup>\*2</sup> [1]. MOAP is used by many mobile Handset Vendors (HSVs), and has promoted more efficient development of software used to provide NTT DOCOMO services.

However, while we are seeing an increased variety of types of mobile terminals and of services provided, issues such as a more mature market and a reduction in shipped numbers of mobile terminals have led to calls for even more streamlined development. Therefore, in addition to the middleware developed in MOAP, NTT DOCOMO has developed software geared towards providing NTT DOCOMO services such as i-mode and i-appli, and has developed the Operator Pack (OPP) that packages these together as a software platform<sup>\*3</sup>. Specifically, as with MOAP, this has been developed in two versions. The OPP for Linux<sup>®</sup> OS<sup>\*4</sup> (hereinafter referred to as “OPP(L)”) and the OPP for Symbian<sup>™</sup> OS<sup>\*5</sup> (hereinafter referred to as “OPP(S)”), which together are used on the majority of FOMA terminals. HSV started using the OPP(L) in winter/spring 2009 models, and the OPP(S) in summer 2010 models (**Photo 1**).

This article will describe the background behind the development of the OPP and a technical overview, and will cover future developments.

### 2. Developmental Objectives

There were three objectives behind the development of the OPP.

- Efficient development of NTT DOCOMO services at a

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\*1 **MOAP**: Middleware (see \*2) that provides shared functionality to applications installed on FOMA terminals, and that streamlines development.

\*2 **Middleware**: Software positioned between the OS and actual applications providing com-

mon functions for diverse applications thereby making application development more efficient.



reduced cost

- Optimized development by working in combination with global platforms containing basic functionality that can be shared with mobile terminals from overseas HSV
- HSVs can use the OPP to concentrate on developing functions to differentiate themselves from other HSVs, letting them provide users with an even richer variety of appealing mobile terminals

As a specific example of cost reductions, software development for NTT DOCOMO services that was formerly carried out by each HSV is now unified in the OPP. A further benefit of integrated software development is that software evaluation can be centralized for each specific OS. For example, we are seeing increasingly complex mobile terminal software such as i-concier

which incorporates operations that straddle multiple other applications and advanced multitasking operations involved in coordinating applications, and these require ever-increasing evaluation. However, evaluation costs can be reduced by integrating the software to evaluate in an OPP for each OS.

Additionally, because the global platform meets many overseas standard requirements, it is comparatively easy for domestic HSVs to develop mobile terminals for the overseas market. By combining the OPP and global platforms, overseas HSV that use global platforms can easily develop mobile terminals for NTT DOCOMO, and this may assist in the emergence of new overseas HSVs.

### 3. OPP Configuration and Functionality

Software on mobile terminals using

an OPP comprises the OPP, global platform, and the HSV independently developed part (**Figure 1**).

The global platform has adopted the LiMo Foundation<sup>\*6</sup> compliant ACCESS Linux Platform<sup>TM\*7</sup> for the Linux OS, and the Symbian Foundation<sup>\*8</sup> platform for the Symbian OS. The LiMo Foundation is a non-profit group that makes decisions regarding, and promotes software platforms for mobile terminals based upon the Linux OS.

The Symbian Foundation is a non-profit group that integrates software contributed by member companies, and by making this open source, stimulates the Symbian ecosystem. In addition to the Nokia S60<sup>TM\*9</sup>, NTT DOCOMO MOAP resources are also being contributed. This also provides a large amount of software and development tools to cover applications, middleware, and OSs.

\*3 **Software platform**: Shared infrastructure. In this article, the software that implements shared functionality for FOMA terminals, and that is provided to mobile Handset Vendors (HSV's).

\*4 **Linux<sup>®</sup> OS**: An open-source Unix-type OS

that can be freely redistributed under GNU Public License (GPL).

\*5 **Symbian<sup>TM</sup> OS**: A mobile terminal OS. The Symbian trademark and logo are trademarks or registered trademarks of the Symbian Foundation Limited.

\*6 **LiMo Foundation<sup>®</sup>**: Trademark or registered trademark of the LiMo Foundation in the United States and other countries.

The HSV independently developed part provides characteristics particular to each HSV, such as pointing device and fingerprint authentication functionality.

### 3.1 OPP Basic Configuration

The OPP comprises three layers; applications, middleware and device drivers<sup>\*10</sup>, and operates in combination with the global platform that includes the OS (Figure 2).

#### 1) Application Layer

The role of applications is to execute the logic that provides the UI and functionality required in order to communicate with the user. OPP applications support all NTT DOCOMO service specifications. Taking standby applications that manage a terminal's standby status as an example, displays such as pictographs<sup>\*11</sup> to indicate signal strength and others, clocks, standby screens or animations, i-channel telops and Machi-chara<sup>\*12</sup>, application start-up through the use of a hardware key and the screen save mode that turns the screen off after a specified period in which no operations have been carried out are all implemented based upon service specifications.

#### 2) Middleware Layer

The role of middleware is to manage the status of applications, and to provide common functionality between these. The application framework that manages application status is linked to the global platform, and controls the

different applications in order that these operate using the same rules.

Functions shared between applications include the UI framework and content management functionality, and these are provided in a format that matches NTT DOCOMO service specifications. The UI framework has drawing functionality, and provides soft keys, dialogs and other UI elements that

are displayed on the mobile terminal screen. Without any special effort, application developers can provide software that has an overall feeling of consistency and that is in accord with NTT DOCOMO service specifications. Content management functionality provides applications with the ability to save and delete items such as mail and still images. For example, when saving

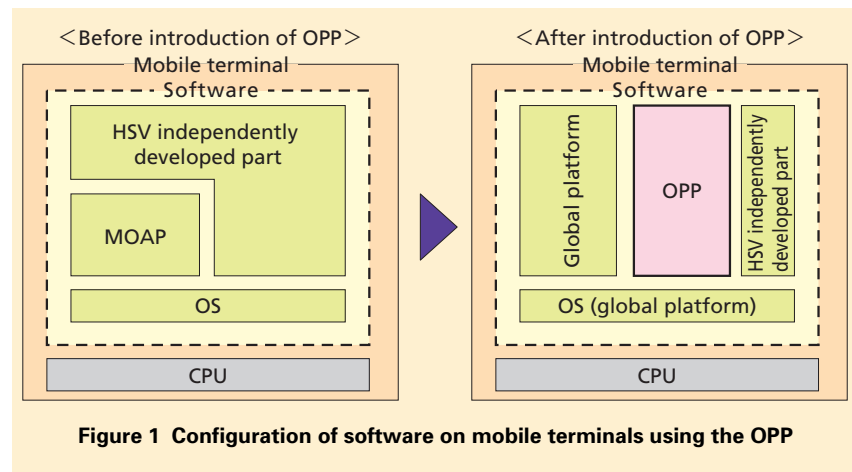
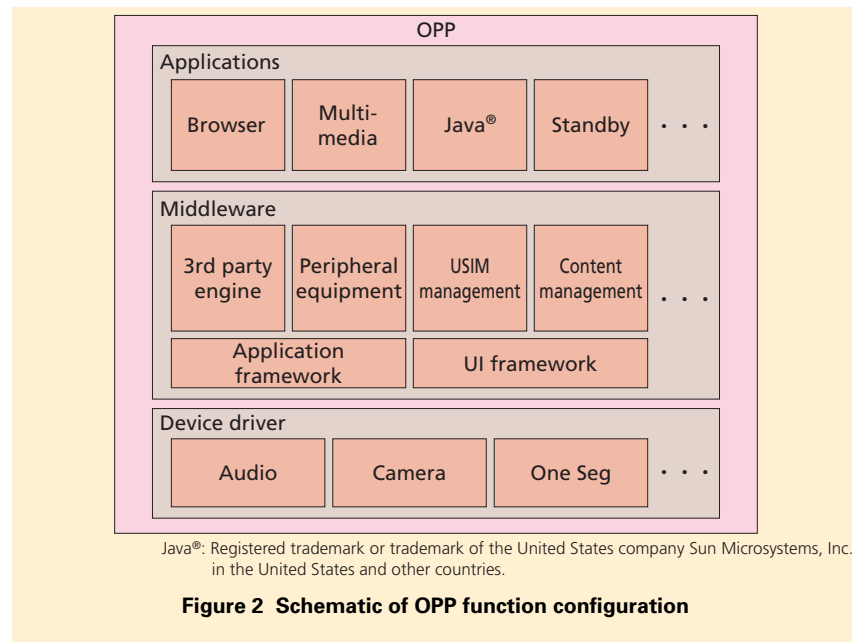


Figure 1 Configuration of software on mobile terminals using the OPP



Java®: Registered trademark or trademark of the United States company Sun Microsystems, Inc. in the United States and other countries.

Figure 2 Schematic of OPP function configuration

\*7 ACCESS Linux Platform™: Registered trademark or trademark of ACCESS Co., Ltd. in Japan, the United States and in other countries.  
 \*8 Symbian Foundation: Registered trademark of Symbian Foundation Limited.

\*9 S60™: "S60" and its logo are trademarks of Nokia Corp.  
 \*10 Device driver: Software for controlling the various hardware components making up a mobile terminal.  
 \*11 Pictograph: Indicates an item displayed as a

picture, not text. In NTT DOCOMO mobile terminals, this includes the i-mode mark and the antenna signal meter.  
 \*12 Machi-chara: A service that displays a character set by the user for mobile terminal standby screens and menu screens, etc.

still images, this checks the file type and size, and determines whether or not these need to be saved as Decomail pictograph content. If so, it will then carry out save processing in order to save the image in the special Decomail pictograph folder.

3) Device Driver Layer

The role of device drivers is to connect the OS to its hardware, enabling applications that use the hardware to operate. The development of the OPP included the development of a mobile terminal for evaluation (Reference Hardware (RHW)), and of an OPP operating environment using device drivers for the RHW. This means that when HSVs develop mobile terminals using the OPP, hardware that differs from that in the RHW can be supported simply by replacing the device drivers, without requiring changes to the application or middleware layers. Examples

of such hardware are accelerometers and cameras.

3.2 Provided Functionality

Functionality provided by the OPP provides NTT DOCOMO services, and infrastructure functionality. Functionality provided by the OPP for up to the summer 2010 models is shown in **Table 1**.

1) NTT DOCOMO Service Functionality

The OPP provides call functionality, as well as existing service functionality (mail, Decomail, i-mode browser, i-appli, i-concier, i-motion, usage guide, data security service, etc.), and from the winter/spring 2009 models, incorporates the latest functionality such as AUTO-GPS. Additionally, performance indicators for each application are decided upon and fine-tuned as a part of OPP development.

2) Infrastructure Functionality

As well as functionality in order to provide NTT DOCOMO services, the following infrastructure functionality has also been developed with the aim of improving the efficiency of development, and of increasing customer satisfaction.

- Modularity

With the objective of facilitating simple adoption of the OPP on an even wider range of mobile terminals, modularity, which enables switching functionality on and off, has been included in the OPP software configuration. For example, this provides modularity in order that turning off functionality for hardware devices such as Bluetooth<sup>\*13</sup> and GSM, which may not be included in some models, will not impact other functionality (**Figure 3**).

Table 1 Functionalities provided by the OPP

Type		Provided functionality		
NTT DOCOMO service functionality	Existing service functionality	<ul style="list-style-type: none"> <li>• Calling</li> <li>• Video phone</li> <li>• Mail</li> <li>• GSM</li> <li>• Browser                             <ul style="list-style-type: none"> <li>✓ i-mode browser</li> <li>✓ Full browser</li> </ul> </li> <li>• Multimedia                             <ul style="list-style-type: none"> <li>✓ Music player</li> <li>✓ i-motion</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Java</li> <li>• 2in1</li> <li>• i-concier</li> <li>• Kisekae tools</li> <li>• FOMA card management</li> <li>• Area mail</li> <li>• GPS</li> <li>• Camera</li> <li>• Code recognition</li> <li>• One Seg</li> </ul>	<ul style="list-style-type: none"> <li>• Bluetooth</li> <li>• FeliCa<sup>®</sup></li> <li>• Infrared</li> <li>• microSD<sup>™</sup></li> <li>• Rights management</li> <li>• Omakase lock</li> <li>• Security scan</li> <li>• Phone book</li> <li>• Standby</li> <li>• Menu</li> </ul> <p>etc.</p>
	New services introduced in winter/spring 2009 models/ summer 2010 models	<ul style="list-style-type: none"> <li>• AUTO-GPS</li> <li>• My Area</li> <li>• Data security service</li> </ul>	<ul style="list-style-type: none"> <li>• Simple 2in1 settings</li> <li>• Music &amp; Video channel improved usability</li> </ul>	<ul style="list-style-type: none"> <li>• UI guide unification</li> <li>• Launch i-appli from scheduler</li> </ul>
Infrastructure functionality		<ul style="list-style-type: none"> <li>• Modularity</li> <li>• Separation of UI and logic</li> <li>• Extendability</li> </ul>	<ul style="list-style-type: none"> <li>• Unified font</li> <li>• Unified FEP</li> <li>• Multilingualization</li> </ul>	<ul style="list-style-type: none"> <li>• Framework integration of global platform</li> </ul> <p>etc.</p>

FEP: Front End Processor

FeliCa<sup>®</sup>: A registered trademark of Sony Corp.  
 microSD<sup>™</sup>: A trademark of the SD Association.

\*13 Bluetooth<sup>®</sup>: A short-range wireless communication specification for wireless connection of mobile terminals, notebook computers, PDAs and other portable terminals. Bluetooth is a registered trademark of Bluetooth SIG Inc. in the United States.

- Extensibility

In order that HSVs can easily customize their own products that use the OPP, NTT DOCOMO has implemented a plug-in configuration in consideration of an extendable architecture upon which functionality for enhanced competitiveness can be provided. This lets HSVs add functionality for independently developed parts without losing any compatibility with the Application Programming Interfaces (APIs)<sup>\*14</sup> provided by the OPP.

- Support for multiple hardware configurations

In order to enable installation on different hardware configurations, a software architecture which distinguishes between hardware-dependent and hardware-independent OPPs was studied as a design concept. Specifically, the hardware-independent portion resides in the middleware layer, and the hardware-dependent portion resides in the device driver layer. This enables support for multiple hardware configurations by changing the device driver layer to match the hardware configuration of the mobile terminal.

Accordingly, in order that the OPP can be an extendable software platform, instead of merely providing a number of service functions, it also implements a variety of approaches as regards software

configurations, and has been implemented as infrastructure functionality.

### 3.3 Establishment of the Development Environment

Two development environments, the Software Development Kit (SDK) and the Product Development Kit (PDK) have been established with the aim of promoting the development of OPP-based mobile terminals and software for these by HSVs and 3rd parties<sup>\*15</sup> (Figure 4).

The SDK is a development environment upon which 3rd parties can inde-

pendently develop software that runs on the OPP, and with this, functionality provided by the middleware layer can be used through the API. This means that 3rd parties can develop software without needing to understand the detailed functionality of the OPP or of the hardware. Moreover, SDK comes equipped with the functionality to simulate a mobile terminal on a PC, where developers check the operation of the software they have developed. In this way, 3rd parties can develop and confirm the operation of software on a PC, even without a mobile terminal. The OPP (L) mobile terminal simulator is

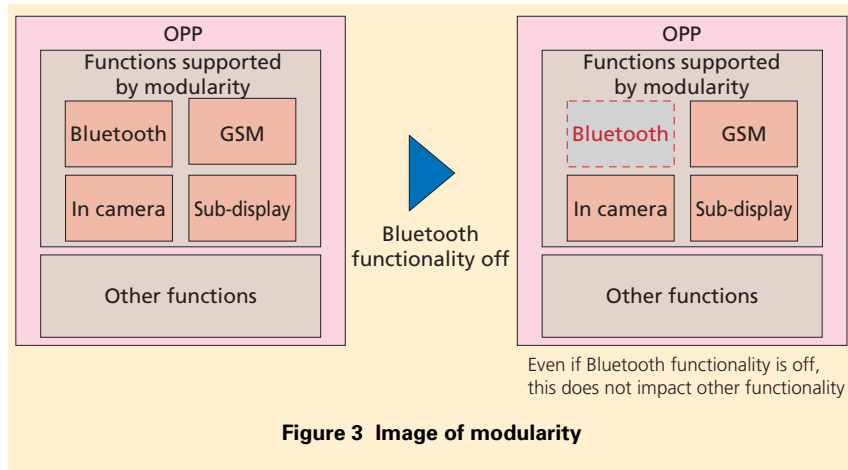


Figure 3 Image of modularity

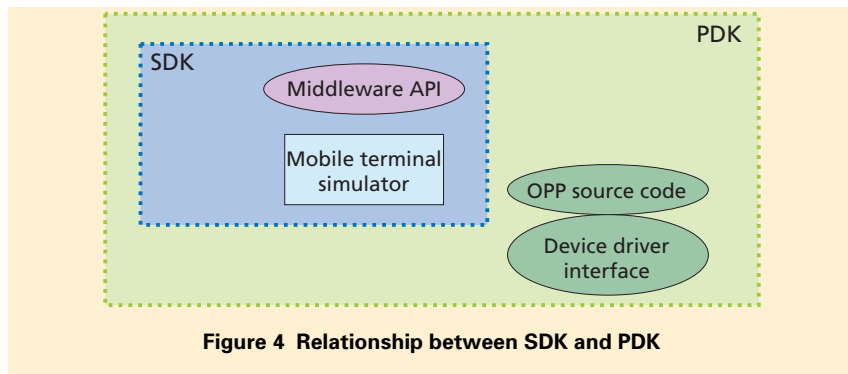


Figure 4 Relationship between SDK and PDK

\*14 API: An interface that makes the functions provided by the OS, middleware and other such software available to upper-level software.

\*15 3rd party: Specialized software vendors that develop software for mobile terminals.

shown in **Photo 2**.

PDK is a development environment with which HSVs can develop mobile terminals that use the OPP. In addition to the SDK, PDK also includes the OPP source code, as well as interfaces and sample code for the device driver layer. By using the device driver layer interface, HSVs can provide support for multiple hardware configurations without needing to change the OPP middle-ware layers or application layers, as described in Section 3.2.

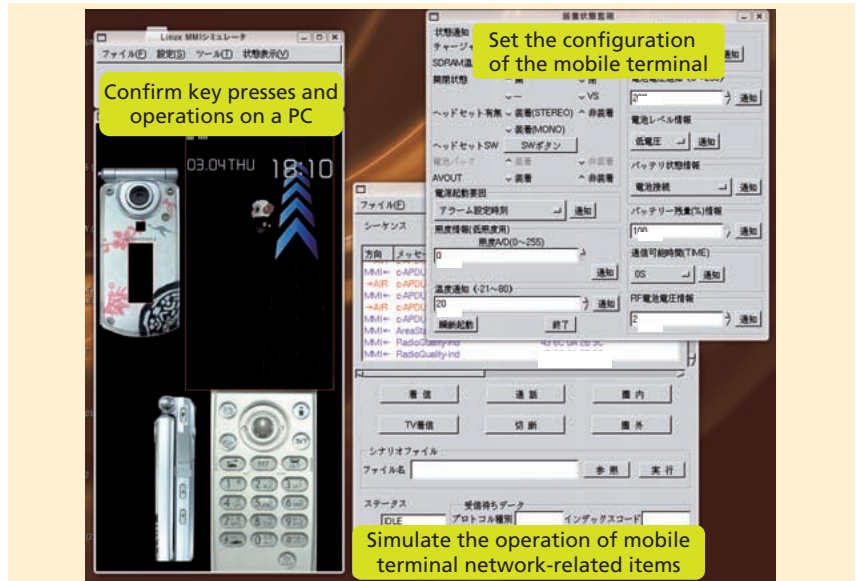
These development environments provide an effective way for HSVs and 3rd parties to carry out development on PCs.

#### 4. Optimizing Evaluations

As previously described, software on mobile terminals using the OPP comprises the OPP, the global platform, and the HSV independently developed part. If the OPP itself is evaluated, then HSVs using the OPP will see a major reduction in software evaluation costs, leading to lower costing for mobile terminals.

OPP evaluation comprises evaluation using the mobile terminal simulator, and evaluation using the RHW.

Because the mobile terminal simulator also simulates communications control and other areas peripheral to those being developed on a PC, its use for all evaluation in the development of mobile terminals is difficult. Accordingly, the RHW was developed and the



\*This is provided only in Japanese at present.

**Photo 2** OPP(L) mobile terminal simulator

OPP installed, upon which this software can be evaluated (**Photo 3**). The RHW enables evaluation on environments connected to commercial networks, significantly increasing the possible scope of evaluation. As a result, the range of evaluation that HSVs need to carry out for commercial development can be further reduced, promising a reduction in evaluation costs (**Figure 5**).

#### 5. Future Developments

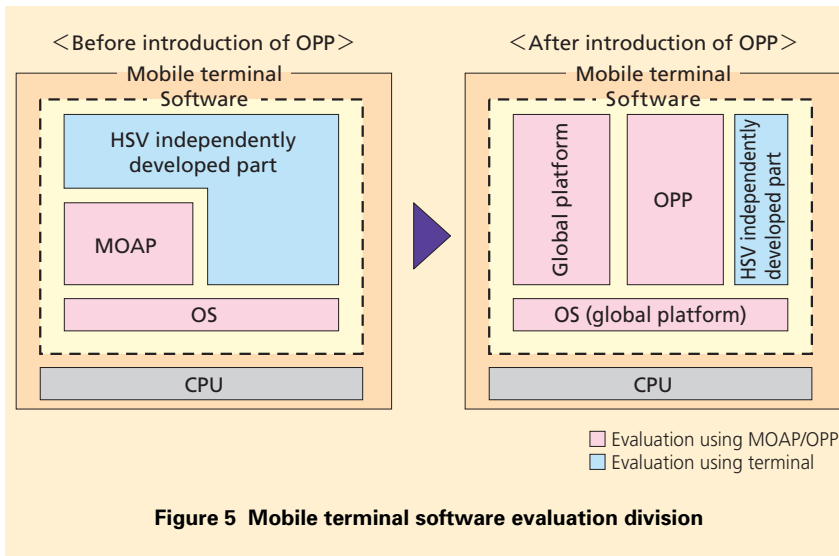
Future OPP will offer improved functionality to match the evolution of NTT DOCOMO services, as well as enhanced infrastructure functionality. In particular, study on infrastructure functionality is currently underway with a focus on the following two points.



**Photo 3** RHW for OPP(L)

- 1) Expanding the Usage Range of Global Platforms

To further promote efficiencies in the development of OPP mobile terminals, we are aiming to increase the usage range of the global platform.



Organizing the range of application of both the OPP and the global platform in response to the enhanced functionality of the global platform adopted in the OPP will promote both the expansion of domestic HSVs into overseas markets, and the development by overseas HSVs of mobile terminals for NTT DOCOMO.

## 2) Enhancing Support for Multiple Hardware Configurations

In order to increase the variety of mobile terminals that use the OPP, we

are expanding support for OPP-supported hardware. At present, mobile terminals using the OPP are concentrated in the higher price range, but by moving forward with support for low-cost chipsets<sup>\*16</sup>, the aim is to add support for the low price range. To this end, we are working towards both an increase in the scope of modularity, and the virtualization of hardware.

In order to promote the overseas expansion of domestic HSVs and the entry of overseas HSVs, we are pro-

moting support for the global use of a common interface that ties together the device driver layer and the middleware layer.

## 6. Conclusion

This article has described the background behind the development of the OPP, the effects of this, and its technical details. In the future, we will use the OPP to implement consumer requests for improvements and other changes in NTT DOCOMO's new services and mobile terminal software. Furthermore, we will aim for a further enhanced software platform for our mobile terminals in order to contribute towards increased customer satisfaction.

## REFERENCE

- [1] M. Yoshizawa et. al: "Special Article on Common Platform Technology for Mobile Terminals / (3) Expansion of "MOAP" Software Platform for Mobile Terminals," NTT DoCoMo Technical Journal, Vol.8, No.1, pp.15-18, Jun. 2006.

<sup>\*16</sup> **Chipset:** A device that controls mobile terminal software and various hardware processing. Devices such as the CPUs and control circuit are collectively referred to as "the chipset."