New Applications in 901iS
—PDF Viewer and Advanced Browser—

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We developed a PDF viewer and an advanced browser as new applications for the FOMA 901iS series.

1. Introduction

Applications for mobile terminals have been upgraded by leaps and bounds during the last few years, and the demand for mobile terminals that are able to display the same contents as those displayed on PCs is growing day by day.

In order to address this demand, we developed two new functions to enhance mobile terminals. The first is a functional expansion of content viewers in existing i-mode browsers. Specifically, we developed a Portable Document Format (PDF) viewer function as a plug-in for the i-mode browsers. The other is the development of an advanced browser that supports scripting, Cascading Style Sheets (CSS)[*1], cookies and the like in order to allow the user to browse Websites with mobile terminals in the same way as with PCs.

This article presents the overview of these two functions.

2. PDF Viewer Function

2.1 Service Concept

We developed the PDF analysis/processing function as a plug-in for i-mode browsers on FOMA terminals, in order to allow viewing PDF files which is one of the most widely diffused document formats on the PC platform. Adobe Reader LE[™ *2] by the US company Adobe Systems, Inc. was adopted as the PDF analysis/processing function to allow easy download and display of PDF documents with i-mode browsers.

2.2 Main Additional Functions for Downloading PDF Files

1) Support for HTTP Range Request

In the past, it was generally not possible to display i-mode

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*1 CSS: A mechanism for specifying the display layout (appearance) of HTML documents.

*2 Adobe Reader LE is a trademark or registered trademark of Adobe Systems, Inc. in the US and other countries.

contents before the entire file was downloaded. For this reason, it has so far been impossible to display contents whose size exceeded the upper limit specified for each content. The PDF files that we are dealing with in this development, on the other hand, can be downloaded to a mobile terminal in a status where the contents are optimized for browsing on the Web (Web Optimized) according to the format specifications. Specifically, if a file is stored in the Web Optimized status, the information required to display the contents is stored within the file in units of objects. Moreover, the layout information for each object is stored in the header and footer parts of the file. To display a certain page of a PDF file, it is only necessary to download the objects required to display that page based on the layout information of the corresponding object; that is, it is possible to display the specified page without having to download the entire file. In other words, to display page X of a document, it is only necessary to download the objects required to display page X. For this reason, the Range Request feature is supported in HTTP, the download protocol, for the PDF viewer developed this time so that a user can download only the objects required to display the desired page. In this way, the user can now download only the data of the pages he/she wants to view and display efficiently even when displaying relatively large-sized PDF files. **Figure 1** shows the Range Request-based download operation. First, a PDF download link described in an HTML document is selected (1). In this status, a normal content download request is sent from the mobile terminal to the server. If the mobile terminal judges that the content is a PDF file based on the response from the server (2), it identifies where in the PDF file the objects required to display the first page are stored based

on the layout information of each object placed in the header part of the PDF file (3) and sends a request to download that part of the file. When all the objects required for the page to be displayed are downloaded in response to the request, the mobile terminal finally displays the first page (4). If operations to view another page of the PDF file are performed afterward, the mobile terminal repeats similar operations to download the corresponding part of the file and displays the specified page. It is also possible to save the objects corresponding to the individual parts of the file as a fragmented file (5).

2) Document Definition File

If the same PDF file is downloaded again via the network after saving the fragmented file and displaying it, it should be possible to continue viewing the subsequent pages without downloading the same objects again from the network. In order to realize this, it is necessary to confirm that the PDF file, which is the source of the saved fragmented file, is identical to the PDF file to be downloaded from the network. For this reason, we prescribed a set of document definition files that correspond directly to the PDF files saved in the mobile terminal on one-to-one basis including fragmented files for displaying parts of a PDF file. A document definition file contains information such as file name, file size, Uniform Resource Identifier (URI) and other properties and is used to confirm the identity of a file before downloading using a checksum value calculated based on the information. If identity of a file to be downloaded is confirmed, the corresponding fragmented file saved in the mobile terminal is displayed, and only aquire the pages that have not been downloaded in addition.
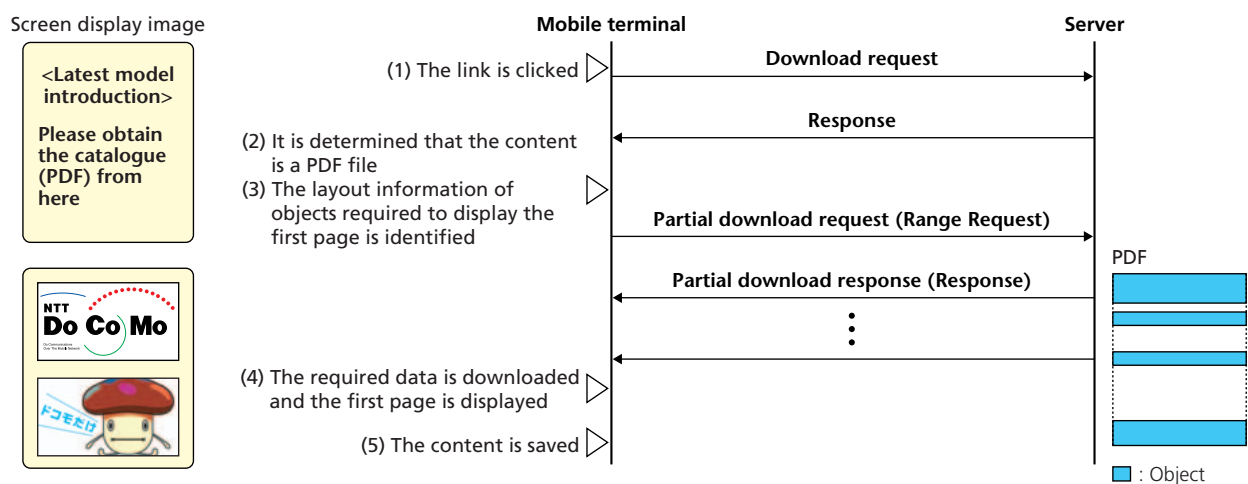
Note that bookmarks, markers and other information can be

Figure 1 Data download example using Range Request

saved in and added to a document definition file in addition to the information described above. This allows users and contents providers to expand the display/expression ability of the documents.

2.3 Main Functions Available during PDF Viewing

1) Document Display Mode

a) Scaling function

All the 901iS models are now equipped with scalable fonts, allowing scaling the display up and down at any magnification in the same way as on a PC.

b) Searching function

While viewing a PDF file, a user can use the character string searching function from the sub menu. The searching range is the entire file, if the file has been downloaded and displayed in its entirety, and limited to the pages that have been displayed if only parts of the file have been downloaded and displayed. Searching for any character string is possible within these ranges.

c) Bookmark function

If "Bookmarks," which refer to information that specifies certain display position and scaling settings within a PDF file, are included in the file in advance by the PDF file creator, it is possible to use the "Bookmark Display" function, which displays the list of "Bookmarks," in the same way as on a PC. A user can select any "Bookmark" displayed on the "Bookmark Display" and display the document according to the specification of the selected "Bookmark."

Moreover, it is also possible for a user to insert "Bookmarks" while viewing a document and add these as "User Bookmarks." Note that "User Bookmarks" are managed within the document definition file.

d) Marking function

A user can insert marker information in a PDF file. Such marker information allows displaying eye marks at specified positions, for instance, allowing the user to superimpose landmarks on a display such as a map display. The marker information is managed within the document definition file.

2) Link Mode

PDF provides hypertext link functionality by specifying tags within a document in the same way as for HTML. In the past, operating via this link functionality could result in complicated or unintended operations because when a PDF file is scaled up and displayed beyond the screen display width, the up/down or left/right scroll operations carried out by the user were tracked

by the link focus. For this reason, we provided a link mode that makes it possible to fix the document display screen and only operate the links within the display screen, in addition to the document display mode explained above. The link mode provides a "web to" function that invokes the browser, a "mail to" function that invokes the e-mail software and a "phone to" function that invokes the phone/video phone function.

3. Advanced Browser

3.1 Service Concept

The 901iS series provides an advanced browser that makes it possible to view Webpages created to be viewed on general-purpose browsers for PCs even on mobile terminals with limited resources. This allows seamless relations between the PC and mobile terminal, and provides services that are same as PCs.

3.2 Functions Provided by the Advanced Browser

Table 1 shows a comparison of specifications between the advanced browser and i-mode browser.

1) HTML 4.01-Support

In addition to Compact-HTML (c-HTML), which is supported by the i-mode browsers installed in existing mobile terminals, the following new elements have been added in the advanced browser.

a) Support for input element type=file attribute

Functions for uploading static images (Graphic Interchange Format (GIF) and Joint Photographic Experts Group (JPEG)) files to a site are supported. This allows accommodation of bulletin boards with images.

b) Support for table elements

With this feature, contents are often displayed in a tabular format on Webpages for PC browsers for various purposes. This allows easy and regular alignment of elements displayed on the screen, either vertically or horizontally.

c) Support for frameset and frame elements

The advanced browser supports displaying Webpages divided into frames that are used as the content layout. This allows the division of contents into several parts and control of each individual frame within the page.

d) Support for script elements

ECMAScript[3] is supported. This allows changing and redisplaying parts of a page dynamically in response to a key

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*3 ECMAScript: JavaScript Specification standardized by the European Computer Manufacturer Association (ECMA).

Table 1 Comparison of specifications between advanced browser and i-mode browser

Specification	Advanced browser	i-mode browser
HTML 4.01		
CSS		(only style attributes)
Script function		
DOM		
Cookies function		
Supported file format (static image)	JPEG, GIF, BMP, PNG	JPEG, GIF
SSL	SSL2.0/3.0, TLS1.0	SSL2.0/3.0
File upload function		
Maximum page size	300 kB	100 kB
Cache size	1 MB	500 kB
Frame page		
Multiple windows	(up to 5 windows)	

SSL: Secure Sockets Layer
TLS: Transport Layer Security

event or other user operations.

2) CSS 1.0/2.0-Support

The existing i-mode browsers already support same CSS functionality, but the support has been limited to only a subset of the functionality as well as to a combination of eXtended HTML-Mobile Profile (XHTML-MP) plus CSS and formats described in HTML documents in advance.

The advanced browser supports a combination of HTML and CSS, which is used for various purposes in Webpages for PC browsers, as well as external style sheets that can be defined as single files separately from the HTML documents themselves. This allows viewing more contents created to be viewed on PCs and expressing richer contents on mobile terminals.

3) Cookie-Support

A general-purpose cookie function is supported. Supporting this cookie function may cause some concerns in terms of security; security countermeasures have thus been taken in the advanced browser, as explained in Section 3.3.

4) Document Object Model (DOM)[*4]-Support

The advanced browser supports DOM Levels 1 and 2. Each function and element supported by the browser is converted to an object and used with ECMAScript, thereby allowing expressing contents in a more dynamic fashion.

5) Additional Supporting File Formats

The browser supports two new static image file formats, BitMaP (BMP) and Portable Network Graphics format (PNG), and allows displaying images in these formats.

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*4 DOM: Interface specification for accessing and operating HTML documents (contents).

3.3 Features of Advanced Browser

1) Support for Multiple Windows

Browsers installed on conventional mobile terminals, including the i-mode browsers, allow to activate a single instance of the browser and handle all displays/controls in a single window. The advanced browser not only allows to activate several (up to five) windows at the same time just like browsers for PCs, but also implements parallel processing of script functions and the like in each window. Moreover, communication and linking between windows are also possible, and the usability as mobile terminal browser is further improved (**Figure 2**).

Note that, as an immediate consequence of allowing launch of multiple windows, the memory consumption increases dramatically at the same time, making memory shortages to occur easily. As a measure to avoid being forced to terminate applications due to memory shortage, the browser checks the free memory space every time a new window is launched and ensures that the new window is not launched if the free memory is insufficient.

2) Support for Horizontal Scroll Display

It is difficult to display Websites created to be viewed with PCs as is on displays mounted on normal mobile terminals in a manner that is easy for the users to see and some contents may be displayed in a very vague and unclear state.

In order to solve the aforementioned problem, the advanced browser makes it possible to extend/display contents on a virtual screen of 800 pixels horizontal$\times$ 600 pixels vertical without having to be aware of the actual display size of mobile terminals when displaying the contents. In this way, it is possible to view

the contents in a manner as close to the way the creators intended as possible by scrolling the display on a mobile terminal up/down or left/right. Moreover, according to the preference of the user, it is possible to switch between "Normal Display Mode" and "Horizontal Scroll Display Mode" in the same way as for display of i-mode contents, thus improving the user convenience (**Figure 3**).

3) Suppression of Automatic Control

While the contents that can be displayed were made significantly richer by supporting scripting, it is necessary to address the risk that operations on mobile terminals may easily be controlled from the server side. For this reason, the advanced browser is equipped with a user permission function that limits automatic control in order to prevent contents from performing
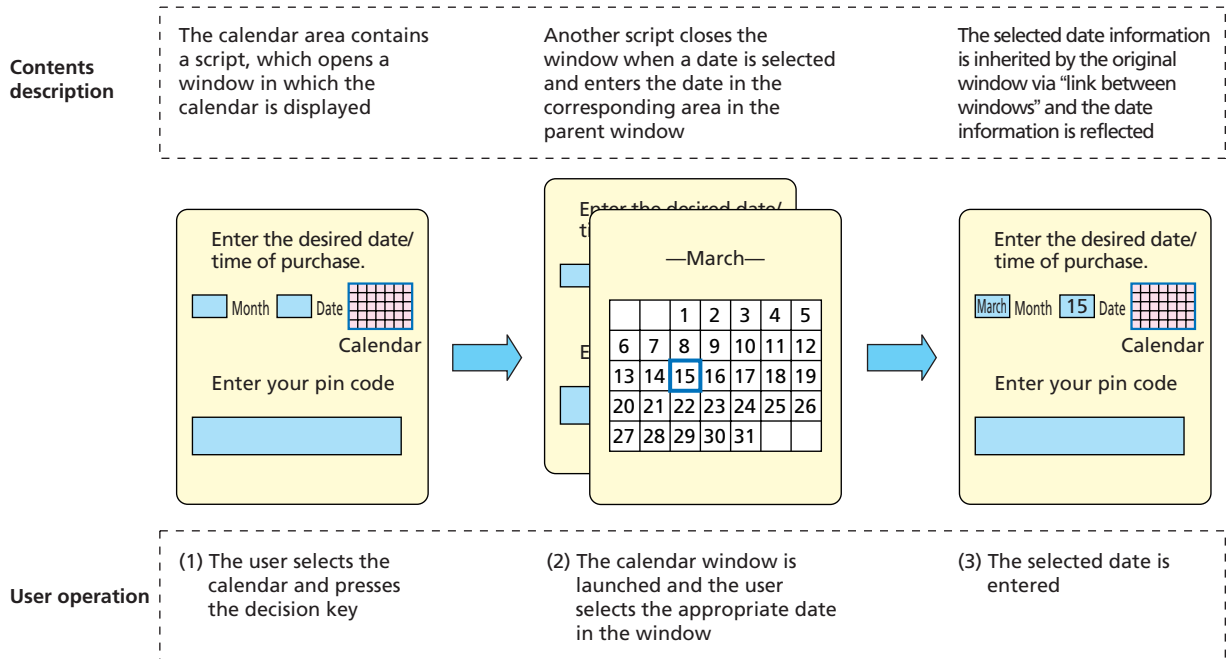

Figure 2 Images of multiple window use and linking between windows

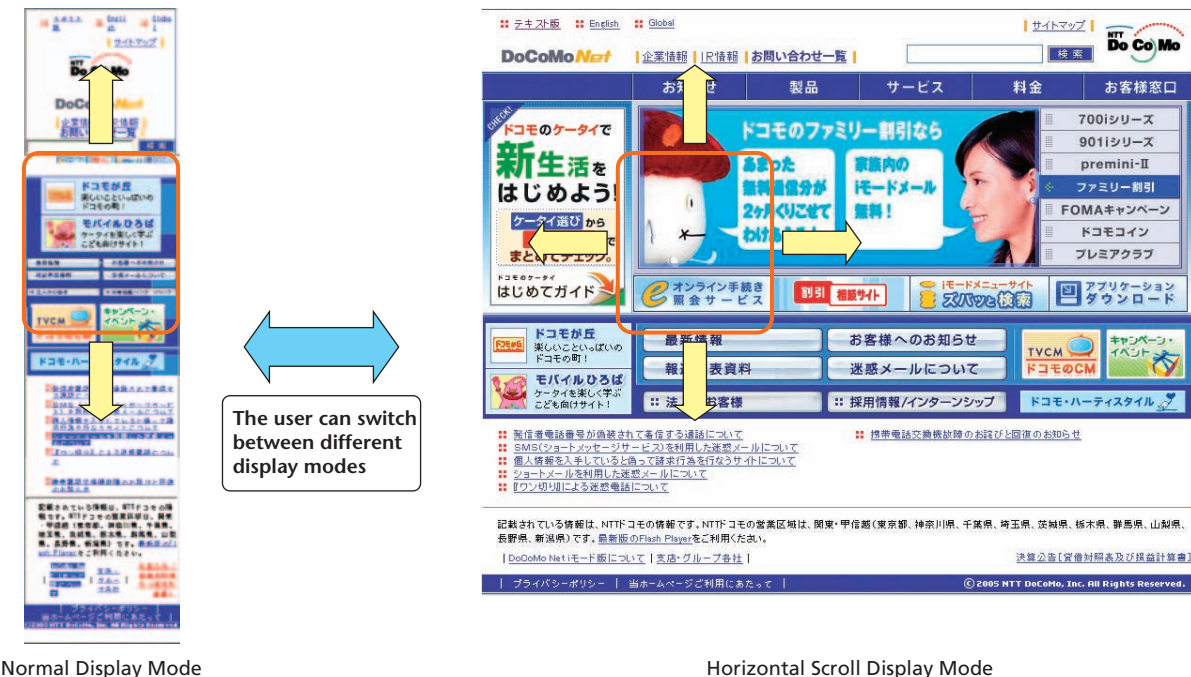Normal Display Mode

Horizontal Scroll Display Mode

Figure 3 Screen display image in each display mode

communication or opening windows automatically despite the users' intention.

4) Security Control of Cookies

Cookie support is very important in making it possible to view Websites made for PCs. However, the cookies themselves may contain personal information and it is thus necessary to take due precautions in terms of security.

The advanced browser ensures the safety of personal information by providing a user not only the function that displays confirmation dialog boxes when writing/reading cookies information, but also prohibiting the use of cookies saved within a terminal at the moment a User Identity Module (UIM) of another person is inserted in the terminal as well.

4. Conclusion

This article described the development of a highly usable, secure, reliable and advanced browser for mobile terminals that takes the limitations of mobile terminals into consideration to the greatest extent possible while adding various browser functions in order to make it possible to view contents for PCs on mobile terminals.

By implementing these functions, the environment for displaying contents on FOMA terminals was further diversified and displaying environment between the PC and mobile terminal became seamless, allowing greater convenience for the users. It is necessary to pursue further expansion of FOMA services and promote development of mobile terminals that can provide attractive services and functions in the future as well.

ABBREVIATIONS

BMP: BitMaP
c-HTML: Compact-HTML
CSS: Cascading Style Sheets
DOM: Document Object Model
ECMA: European Computer Manufacturer Association
GIF: Graphic Interchange Format
JPEG: Joint Photographic Experts Group
PDF: Portable Document Format
PNG: Portable Network Graphics format
SSL: Secure Sockets Layer
TLS: Transport Layer Security
UIM: User Identity Module
URI: Uniform Resource Identifier
XHTML-MP: eXtended HTML-Mobile Profile