Study on Development and Application of #-Mail Solution Based on Publicly Authorized Electronic Address

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Abstract

The existing e-Mail could not act as legal evidence due to the lack of the non-repudiation functionality that the related matter has or has not been transferred between the related parties. From such perspective, the publicly authorized electronic address-based #-Mail has the greatest characteristic that distinguishes it from the existing e-Mail by issuing distribution certificate for non-repudiation through publicly authorized document repository. Also, in Korea, #-Mail has been recognized as one of the legal trade proof documents such that publicly authorized electronic address-based #-Mail solution is in development. In this study, under such motive, the publicly authorized electronic address-based #-Mail solution that can function as a distribution client was developed and the study that distinguishes itself from the application of activating such #-Mail was conducted. New functions were suggested as implementation cases, this study can be said to have a distinguished significance from the existing studies.

Keywords: *Electronic Document, Authorized Electronic Address, e-Mail, #-Mail Solution*

1. Introduction

An electronic document can be described as a digital record rendered comprehensible by both machine and human for information exchange [1]. The Korean government has promoted policies to strengthen the distribution of such electronic document, most important of which is the 'publicly authorized electronic address (#-Mail)' service. Publicly authorized electronic address is an identification information where transmission/reception of electronic document, user check, and non-repudiation are guaranteed, and the electronic trade basic law was created by accepting electronic trade model law of UN international trade law committee (UNCI-TRAL) with the service that provides receipt check and contents certification by converting registered mail to online [8].

To operate publicly authorized electronic address-based #-Mail service, publicly authorized electronic address-based #-Mail solution, publicly authorized electronic document repository, and publicly authorized electronic addresses are necessary. The objective of this study is to develop publicly authorized electronic address-based #-Mail solution centering on non-repudiation function and suggest idea for vitalization of #-Mail among these.

2. Theoretical Background

2.1. Considerations for Mail-Related Precedent Study

Recent studies related to e-Mail span from patents on personalized e-Mail send/receive methods to areas grafted with new media such as IPTV [11, 12, 10, 2, 13, 5, 4, 1].

Table 1. Literature Review of Mail-related Studies

Researcher	Topic
Oliver, Jonadan (2012)	Personalized e-Mail delivery
Mayans, Json (2012)	Method of manipulating and displaying e-Mail conversations
Chen, S. (2011)	Method of packaging and displaying an e-Mail
Park, M. (2011)	Design of XMP-Based Electronic Document Architecture for Electronic Circulation of Litigation Documents
Kim, J. (2011)	System for Providing Multimedia e-Mail Service using Augmented Reality
Lee, H. (2009)	e-Mail reception technology in IPTV environment
Choi, J., Jang, H., Cho, J. (2005)	Design & Implementation of an e-Mail Worm-Virus Filter- ing System on MS Windows
Song, B. (2004)	A Study on the Direction of Electronic Document Inter- change for Korean Government

As the result of examining precedent studies as in Table 1, there are various studies related to e-Mail in progress, but there is no study dealing with the improvements and issues of the existing method from the perspective of utilization such as non-repudiation function of e-Mail solution, and this study is significant in this sense.

2.2. Comparison of Technological Model of e-Mail and #-Mail

The electronic document distribution method utilizing e-Mail has been recognized for its convenience so as to quickly replace the existing paper mail, but its proneness to forgery/falsification and weakness against security are issues that prevents it from securing legal status as a publicly confident document [6].

However, #-Mail has the characteristics to resolve the problems of the existing e-Mail solutions such as guaranteeing the legal evidentiary value of electronic document, and has differences in the aspects of security of legal evidentiary value and communication protocol, and the details are as in Table 2 [6].

Table 2. Comparison of e-Mail and #-Mail Function

Class	e-Mail	#-Mail
Delimiter	@(at)	#(Sharp)
Legal evidence	N/A	Indication of publicly authorized electronic address in electronic trade basic law
Message security	N/A (supported depending on portal/company providing mail service)	Contents encryption
Rejection prevention		Issuance of electronic signature and distribution proof
Transmission guarantee		Issuance of distribution proof (trans- mission, reception, check) When document distribution fails, retransmits through distribution hub
Document format	N/A (simple attachment)	Electronic document format register support (Can be linked to task system in the company)
Communication protocol	SMTP	HTTP (Hypertext Transfer Protocol) ebMS (ebXML Messaging Service)

As laid out in Table 2, #-Mail provides different functions from the existing e-Mail, and it can also be seen that the two technological models as in Table 3 have differences. They show differences in each of communication protocol, method of implementation and process, and the greatest difference is of the protocol structure as in Figure 1.

Table 3. Comparison of Technical Models of e-Mail and #-Mail

Classification	e-Mail	#-Mail
Communication protocol	SMTP 1 layer structure	Multi-layer structure centering on ebMS, HTTP
Implementation	Text-format simple structure	Composition in the form of xml document
Process	User checks document with POP3	Same sending/receiving proto- col

As in Table 3, #-Mail has a different technological model as e-Mail, and this is due to the difference in the protocol structure, and it is like Figure 1 [6].

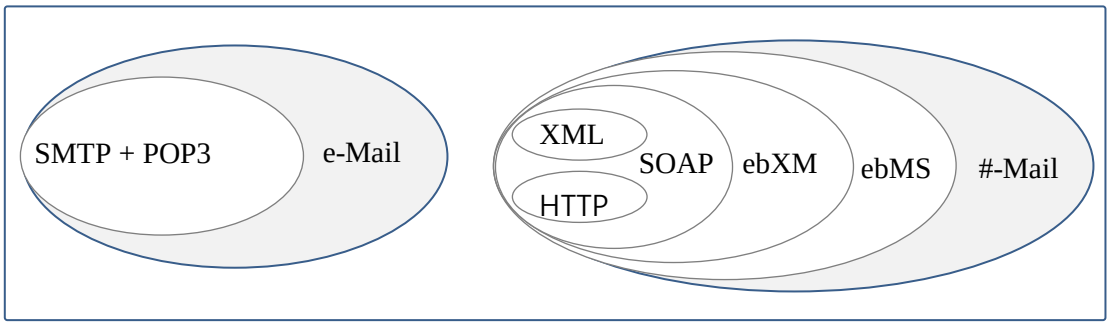

Figure 1. Comparison of e-Mail and #-Mail Protocol

In Figure 1, the existing e-Mail Protocol is of text-format simple structure, but on the other hand, #-Mail Protocol has the protocol structure that reflects the standard for treatment. For #-Mail Protocol, XML is the document standard, and there is a security data structure, and such XML, HTTP, and electronic signature are packaged through SOAP. For such message, the data exchange standard of ebXML is reflected, and ebMS for error-checking, linked processing, and encryption/decryption is applied, and it consists of public certificate, distribution proof and address registration/management function necessary for #-Mail distribution.

3. #-Mail Solution Development based on Publicly Authorized Electronic Address

3.1. #-Mail Solution Architecture

#-Mail solution mainly provides #-Mail preparation, sending/receiving, and user authentication, and consists of architecture like Figure 2.

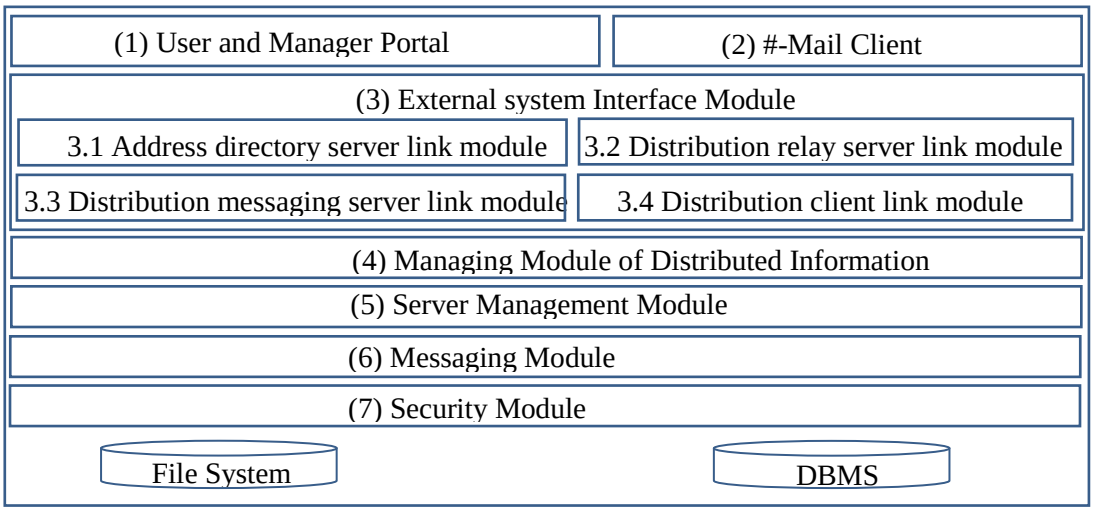

Figure 2. #-Mail Solution Architecture

In Figure 2, the user interface such as "User and Manager Portal" consists of portal-format UI (User Interface), and the layer below consists of External System Interface Module, and it provides functionality to register, change, and delete publicly authorized electronic address. Also, as in 3.2, the message transmission request and processing result are received through connection module of distribution connection server, and through such function, (4) the distribution information management module manages the distribution information such as distribution proof, below which is the server and messaging management module to execute user management, message structure verification and such functions, and lastly there is the module for security such as encryption/decryption of sent/received message. Through such function composition, publicly authorized electronic address-based #-Mail solution can operate.

3.2. Non-repudiation Process and Function Implementation of #-Mail

Non-repudiation function of #-Mail is established by issuance of distribution proof through intermediary and storing it, and such process is as in Figure 3.

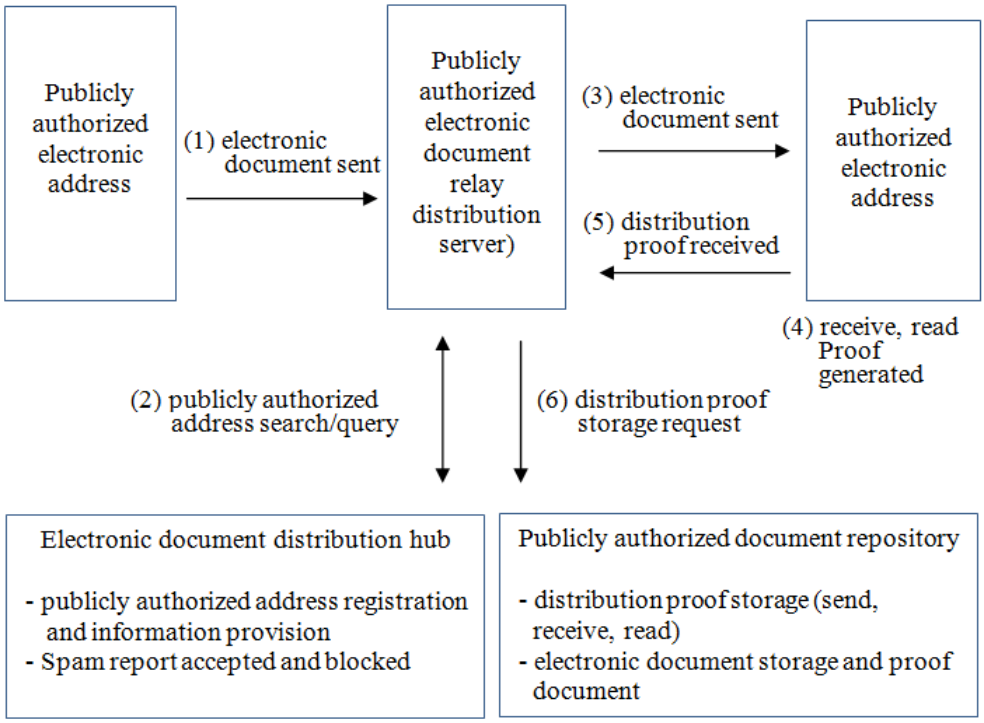

Figure 3. Non-repudiation Process of #-Mail

The non-repudiation function, which is the greatest characteristic of #-Mail, is provided through process as in Figure 3 and #-Mail solution architecture composition such as Figure 2, and the actual implemented function is as in Figure 4. In Figure 4, there is the 'sent/ receipt/read' check function, which allows non-repudiation, and this is provided through (1) "User and Manager Portal" of Figure 2.

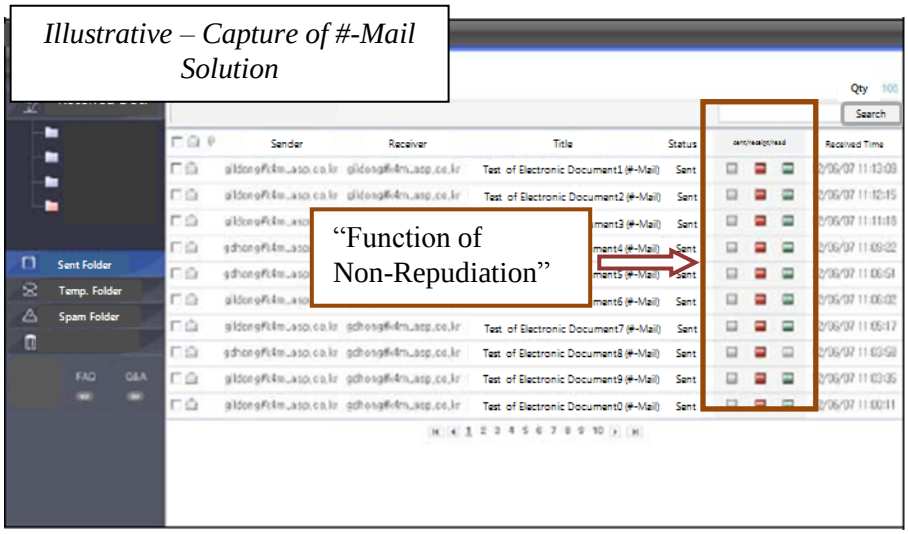

Figure 4. Non-repudiation Function of #-Mail Solution

This #-Mail solution as shown in Figure 4, effects in four aspects may be created. First, work efficiency increases by reducing time in distributing documents due to its efficiency. Second, in the economical aspect, economical effect can be obtained by reducing costs in distributing documents. Third, in the aspect of transparency, work transparency improves by storing and demonstrating distributed documents. Lastly, in the aspect of stability, it ensures the security and accuracy of document distribution.

With all these effects, #-Mail can be used in many fields. First, it can be used in distributing documents among companies, such as sending and receiving documents, receiving proposals, and making electronic agreements in B2B trading. Second, it may be applied in distributing documents between companies and individuals, such as issuing and receiving bills for electricity, gas, telephones, applying for transcripts, certificates of graduation, track records, employment and issuing them, and completing bank account opening forms, loan requesting forms, *etc.* prevalent in financial transactions. Third, it can be used in distributing documents between individuals such as in making agreements on real estate transactions and purchasing goods and sending and receiving important documents. Lastly, it can be used in distributing documents between the government and individuals or companies such as issuing and receiving official documents, civil affair documents, tax documents, bills and notifications, *etc.*

3.3. Key module of #-Mail Solution

#-Mail solution has key modules which consist of the module for distributing messages through #-Mail and the module for management of distributed information to manage confirmation of distribution.

First, the function of non-repudiation, the most significant feature of #-Mail is as shown below. In the message box of messages from senders, the module for distributing messages sends and receives SOAP messages according to HTTP/S. According to technology standard of distributing and connecting messages, SOAP messages are packaged and the packaged messages are analyzed. Data is extracted from each item and the structures of the packaged messages are verified. The module has functions of storing sent and received messages. The details of main development are as shown in Figure 5.

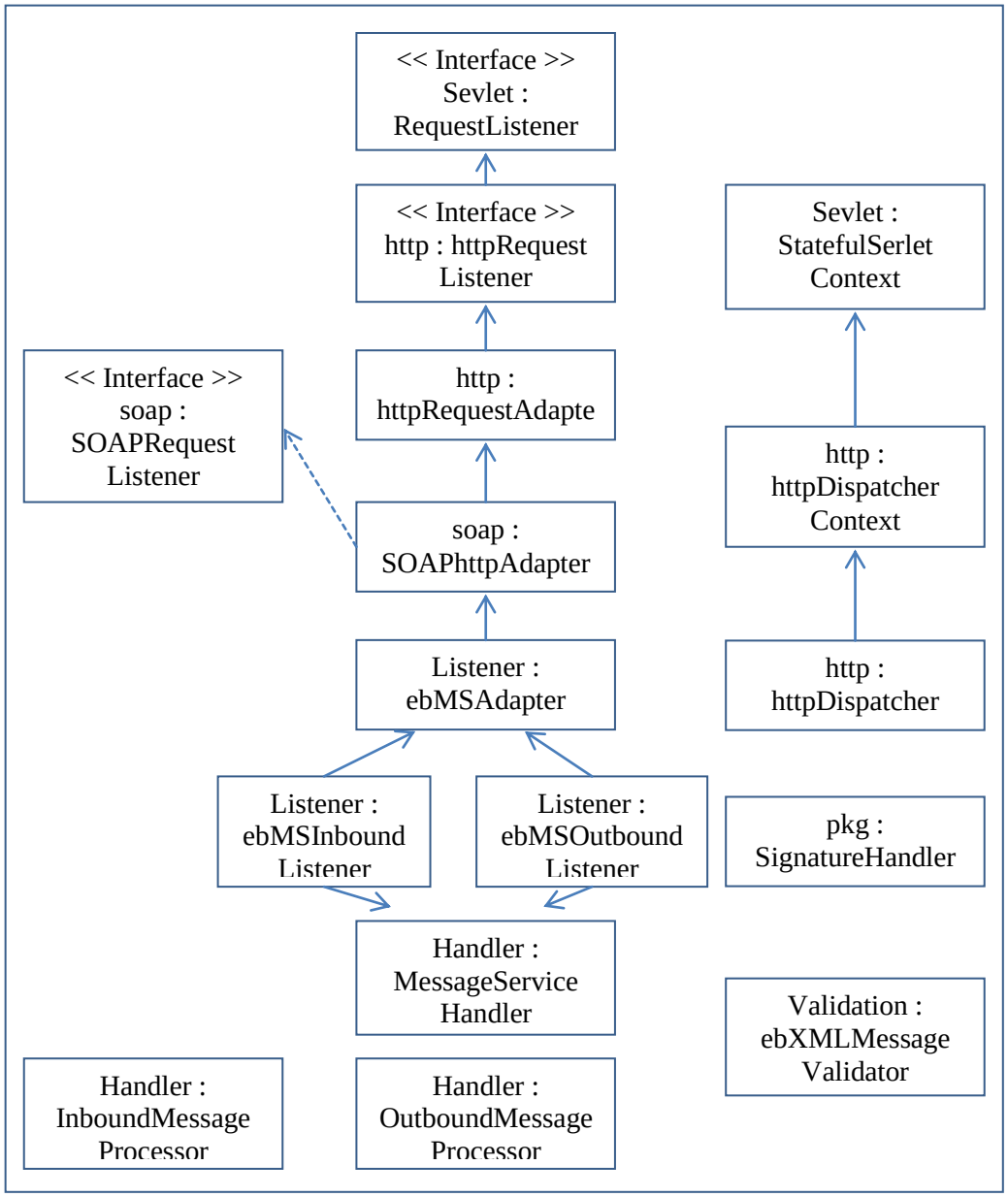

Figure 5. Details of Main Development in the Module for Distributing Messages

Next, with regard to the module for management of distributed information which manages distributed information by checking confirmation of distribution, this module is developed to offer a wide range of functions from managing authentication certificates which register, modify, delete official authentication certificates on the distribution server to managing certificates of distribution (generating, verifying, extracting data, and checking), managing certificates of distribution (generating, verifying, extracting data, and checking), managing distributed messages (generating, verifying, extracting data, and checking) and managing message boxes of sent and

received messages by user (registering, deleting, checking). The functions of this module help to check whether documents were sent or received as shown in Figure 4.

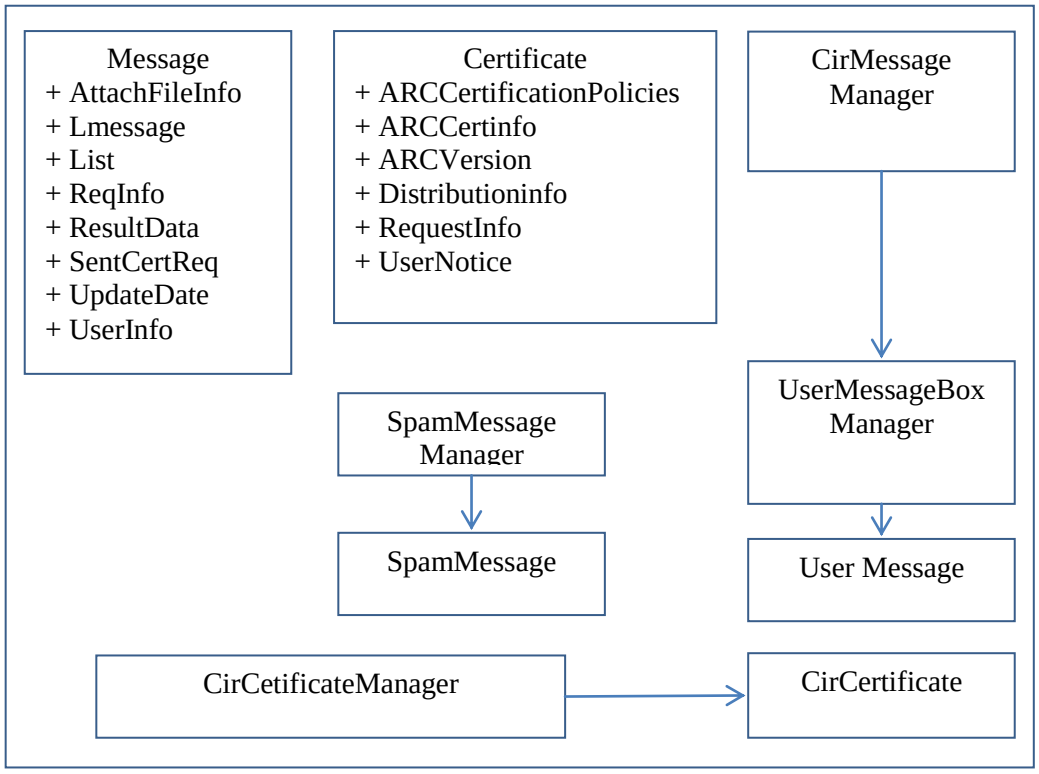

Figure 6. Details of Main Module for Management of Distributed Information

The function of non-repudiation in #-Mail may be offered by developing module functions as in Figure 5 and Figure 6. The development of #-Mail solution has many differences from existing e-Mail and has advantages at the same time. These have been introduced with the focus on the function of non-repudiation. #-Mail cannot be operating with solutions only but the following as in 3.4 should be prepared in advance.

3.4 Preparation Before using #-Mail

In order to use #-Mail, three preparations need to be done. First, 'the official electronic address' should be registered and then 'the official authentication certificate' should be prepared. During this process, corporate or business users need (#-Mail) authentication certificates for corporations or for special purposes. Individual users are identified by using authentication certificates for general purposes or mobile phones and credit cards. Lastly, #-Mail cannot be used without knowing the recipients' official electronic addresses. The official electronic addresses generated during this process cannot be transferred to others.

3.5 Precautions when using #-Mail & Other Functions Provided

As shown on Figure 1, the transport protocols of e-Mail and #-Mail are different. Therefore, attention needs to be paid that it is impossible to send and receive documents from e-Mail to #-Mail or from #-Mail to e-Mail. This results from the added protocol function to offer specialized functions of #-Mail such as Non-Repudiation.

#-Mail has a function of blocking spam mail other than its typical features such as Non-Repudiation. Whereas e-Mail senders can send documents hiding his/her identity, #-Mail senders cannot send documents hiding his/her identity because #-Mail identifies senders and recipients with official electronic addresses. When sending #-Mail, fees are charged so that it is difficult to send advertisement e-Mails addressed to unspecified individuals. Spam mail coming from specific official electronic addresses can be blocked.

#-Mail applies a security device to improve security and reliability in distributing electronic documents. It has systematical devices of managing user accounts and authentication certificates with safety, of applying SSL on the network to send documents with security, and of supporting electronic signatures and password functions to secure messages. In addition, even system managers are not allowed to see messages or delete them and with the function of official electronic document intermediary, all history such as system access information cannot be edited or deleted.

There are three ways of using #-Mail as mentioned so far. First, by using official electronic document intermediary, companies and individuals can apply for official electronic addresses for registration and use #-Mail as provided by official electronic document intermediary. Second, by using client of official electronic document intermediary, client software of the official electronic document intermediary can be installed to get connected to the internal system of the company and to use #-Mail reducing the costs for establishment and operation of #-Mail server. Lastly, by establishing own #-Mail server, #-Mail can be used only when conformity of the #-Mail server is verified.

#-Mail solution and service was developed in Korea for the first time in the world and it is now at its early stage. Some parts of its system such as billing system needs to be modified but it has many environmental advantages in reducing paper documents significantly and reducing carbon emission accordingly.

4. Conclusion and Future Work

This study examined the implementation of functions distinguished from the existing e-Mail centering the non-repudiation function of #-Mail. In the aspect that new functions were suggested as implementation cases, this study can be said to have a distinguished significance from the existing studies.

In order to vitalize #-Mail examined in this study, it needs to advance from the current solution supplied in the form of portals, and when it can function as component embedded in the existing portals (naver.com *etc.*), and also when it becomes established as an option in the mail sending functions of Microsoft Outlook, it would be able to find itself as a more user-friendly #-Mail. And, the business model of the intermediary should have a consider in character towards a government-led public service, and finding a plan to lower intermediate costs such as registration service or certification of contents could be a practical plan for vitalization. Therefore, subsequent studies are needed from the perspective of vitalization of electronic document in its early distribution along with technical studies.

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