Using M2M in eMoney Payment System for Vending Machines

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Abstract

The number of vending machines that accept eMoney for payment has increased in recent years. This is because eMoney has characteristics that are well suited for automatic vending, such as making small change unnecessary. In order to process eMoney, most vending machines use wireless communication, therefore vending machines may be considered an example of M2M applications. In this paper we will offer an overview of eMoney processing in vending machines, usage of wireless communication in vending machines, and discuss the future image of eMoney processing in vending machines based on M2M platforms.

Keywords

eMoney, electronic payment, vending machines, multi-service reader/writer, payment gateway multi-service security, multi-service gateway

1. Introduction

Vending machines are devices that enable unmanned sale of beverages, etc. by automatically handling the processes of goods selection, receipt of payment, delivery of goods, and so on. At the end of 2010, there were close to 4 million vending machines in Japan. [1] Vending machines have become an indispensible infrastructure for Japanese consumers, as they are located throughout the nation and enable casual purchasing of drinks and such.

Conventionally purchasing an item from a vending machine required the insertion of cash (coins or paper bills), however starting in the latter half of 2000s, vending machines utilizing contactless IC card technology [2] to allow purchase by eMoney began appearing. eMoney is said to be well suited for use in vending machines, as it offers the benefits of faster processing than coin insertion, enables purchase of goods without cash, and reduces the risk of theft. Due to these factors, the number of vending machines that accept eMoney continues to increase.

With eMoney, payment is processed electronically through the exchange of data, rather than through the exchange of physical cash such as coins and bills. eMoney enabled vending machines communicate such data with eMoney center servers using public wireless networks and other means. Since the vending machines use wireless networks to communicate, eMoney processing in vending machines can be considered an example of M2M applications.

In this paper, we will outline the information processing and infrastructure usage of eMoney compatible vending machines, introduce NEC's eMoney payment platform, and discuss the possibilities of the M2M platform in regards to vending machine eMoney processing.

2. eMoney Payment in Vending Machines

2.1 Overview of eMoney Payment Processing

The vending machine processes payment through the exchange of electronic data rather than receiving money in cash form. Please refer to **Fig. 1** while reading the following eMoney processing outline for vending machines.

1) The consumer purchases goods from the vending machine using an eMoney card. [*1]

2) At this point, eMoney corresponding to the amount of the purchase is withdrawn from the consumer's eMoney card. [*2]

[*1] Currently in Japan, two media exist for using eMoney: by plastic eMoney card, or by the eMoney function equipped on mobile phones. In this paper, both types are referred to as "eMoney card".

[*2] In the case of prepaid eMoney.

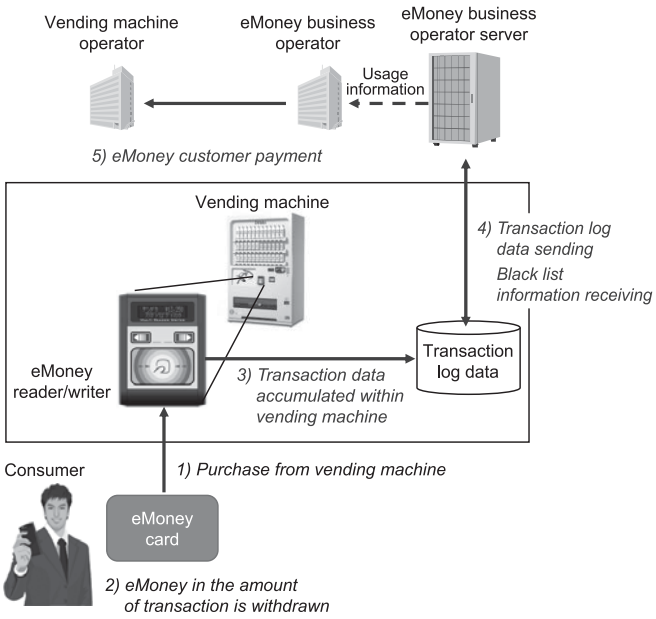

Fig. 1 eMoney process overview.

3) Simultaneously, log data recording an account of the transaction is stored on the vending machine’s eMoney reader/writer.

4) The log data stored in the vending machine is sent to the eMoney business operator at set intervals, such as once a day. At the same time, other data such as black list information is received from the eMoney business operator’s server. [*3]

5) Log data is tallied by the eMoney business operator, and funds are transferred from the eMoney business operator to the vending machine operator’s account.

The repetition of the above steps constitutes the vending machine eMoney payment process.

2.2 Multi eMoney Services

A number of eMoney services exist in Japan today. Many of them, such as Edy [4] , iD [5] , QUICPay [6] , Visa Touch [7][8] , and WAON [9] have gained a large following as nationwide brands of eMoney.

In section 2.1, we discussed the case of using one type of eMoney. However, as a reflection of Japan’s current eMoney situation, we are seeing an increase in vending machines that can handle multiple types of eMoney. For example, with the multi-service reader/writer system [3] offered by NEC, it is possible for a single vending machine to accommodate up to 5 different types of eMoney, namely Edy, iD, QUICPay, Smartplus/Visa Touch, and WAON. Since the Multi-Service Reader/Writer system makes it possible to use eMoney regardless of the type of eMoney card, it has the effect of promoting eMoney usage.

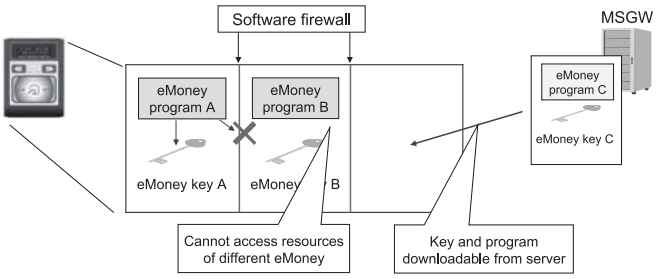

Fig. 2 Realization of multi-services in MSRW.

(1) Multi-service reader/writer (MSRW)

To achieve the Multi-Service Reader/Writer system, NEC provides two products. One is the Multi-Service Reader/Writer (MSRW). MSRW offers the following functions (**Fig. 2**) to enable provision of multiple eMoney services.

1) Multi-service security functions

MSRW allows multiple eMoney service card access keys and card access programs to be stored on a single reader/writer. The key is stored inside a high-security hardware component called SAM (Secure Application Module) and it is not possible to find the location of the key from outside. The program is encrypted and, likewise, cannot be read from the outside. What’s more, the different eMoney service access keys and access programs are separated by a software type firewall so that each different eMoney service will not be able to access the keys or data of another eMoney service. By virtue of these functions, it is possible to safely provide multiple eMoney services in one MSRW unit.

2) Online installation function

With MSRW, the aforementioned access key and access program can be downloaded from the server and installed. This function makes it possible to add eMoney services online to a vending machine even after it has been installed. This way, appropriate services can be offered in accordance with demand.

[*3] Black list information refers to data including the numbers of eMoney cards that have been stopped or cancelled.

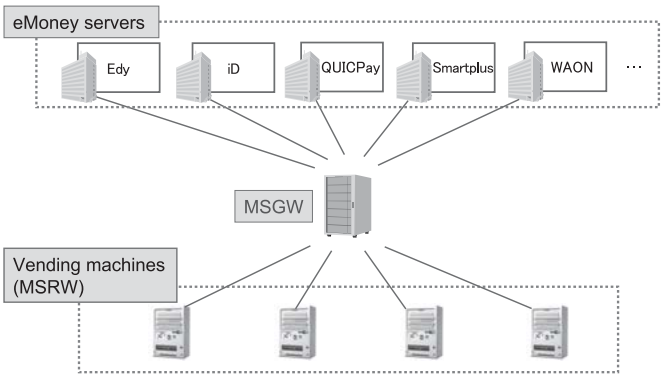

Fig. 3 Outline of MSGW.

(2) Multi-service gateway (MSGW)

The other solution that makes the Multi-Service Reader/Writer system possible is the Multi-Service Gateway(MSGW). MSGW manages the different types of eMoney that MSRW incorporates, as well as relaying and tallying the data that MSRW sends to the eMoney server (**Fig. 3**). In other words, instead of having MSRW send transaction data to each different eMoney server individually, all of the eMoney transaction data is sent to MSGW, and then MSGW sends the data to each eMoney server. The advantage of this is that it relieves MSRW from having to establish separate communications with multiple eMoney servers. Moreover, eMoney servers also benefit from this because they do not have to separately process the data transfer requests that are sent to them from numerous MSRW terminals.

3. Communication Infrastructure for eMoney Vending Machines

To process eMoney payments as explained in section 2, eMoney compatible vending machines use a communication infrastructure, of which both wired and wireless connections are available. Wired connection is used mainly in buildings and train stations when it is possible to use the existing network resources that are already in place, however perhaps due to the time and effort required to correctly implement the wiring and network device settings, wireless connection has become the mainstream.

In performing wireless connection, it is common to use a mobile phone network such as FOMA. [10] Set-ups include cases where a wireless modem (router) and antenna are built into the vending machine, as well as having an internal eMoney reader/writer connected to an external wireless modem (router) via LAN.

Using a public mobile phone network for connection means that this communication cost will always account for a certain percentage of the overall eMoney operating cost. A number of innovations have been considered to reduce this communication cost, and this section will discuss those.

1) Consolidation of mobile phone lines

It is common for a number of vending machines to be positioned in close proximity. In such cases, instead of having the machines use 1 phone line each, it is possible to have multiple machines share one line in order to reduce the basic charge for communication. NEC's eMoney reader/writer for vending machines consolidates multiple vending machines into one phone line by using a uM router [11] equipped with three LAN ports.

In the midst of such cost reduction measures, there have been cases where adjacent vending machines were operated by different companies, making it impossible to consolidate phone lines. For further reduction of communication costs, it will be necessary to solve these constraints that exist on the business end.

2) Data transmission at night

As a general rule, eMoney processing is done offline, therefore it is not necessary for the vending machine to communicate with the server every time there is a transaction. [*4] Most communication can be batch processed once per day or so. Typically communication traffic on mobile phone networks goes down during the night, freeing up more resources. So, by performing eMoney communication batch processing only during the night hours, it will be possible to communicate at a discounted rate and thereby reduce overall cost.

The measures for communication cost reduction outlined here pertain only to cases where eMoney services are involved, and their effectiveness may be limited. For the future, we must consider using wireless networks that do not rely on public mobile phone networks, and offer a variety of services in addition to eMoney, in order to more effectively reduce communication cost.

[*4] Certain types of eMoney require online communications at a certain frequency when a transaction occurs, but since this is only around once in every 100 times, the impact on communication costs is negligible.

4. Using M2M Platforms in Vending Machines

In addition to eMoney payment, vending machines have other services such as the stock control system utilized to enable the operation center to monitor a vending machine’s stock and sales status. More recently there has been a rising need to comprehend and control electricity usage for the purposes ofenergy saving. In the future, we may see the emergence of services that gather temperature, noise, and other measured values from sensors installed in vending machines.

Currently, multiple services like these each operate under their own communication networks and server systems (**Fig. 4**).

It is thought that in the future, processing of vending machine services will change dramatically as M2M communications becomes more widespread and an M2M platform that handles M2M communications in a cohesive manner develops. **Fig. 5** shows an image of vending machine communication services utilizing this M2M platform.

As data for various services is generated by vending machines, it is transmitted through communication lines that have been consolidated for M2M purposes, to the M2M platform server. At the M2M platform, necessary data is extracted and distributed to each server that will do the processing.

By using such a system, it will be possible to consolidate communication lines and share the same data among multiple applications. [*5] What’s more, since it is easy to add new

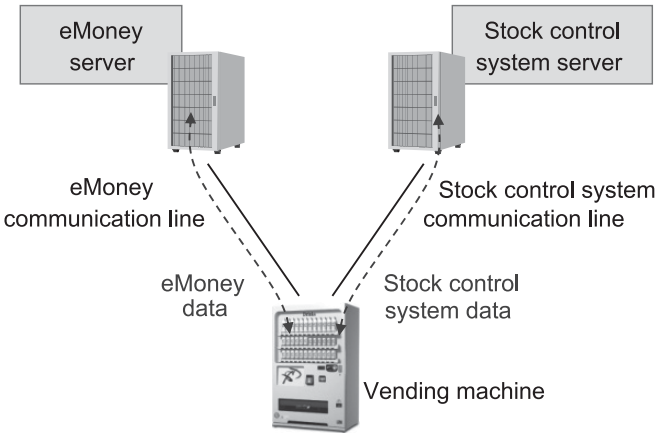

Fig. 4 Relationship between multiple services in vending machine.

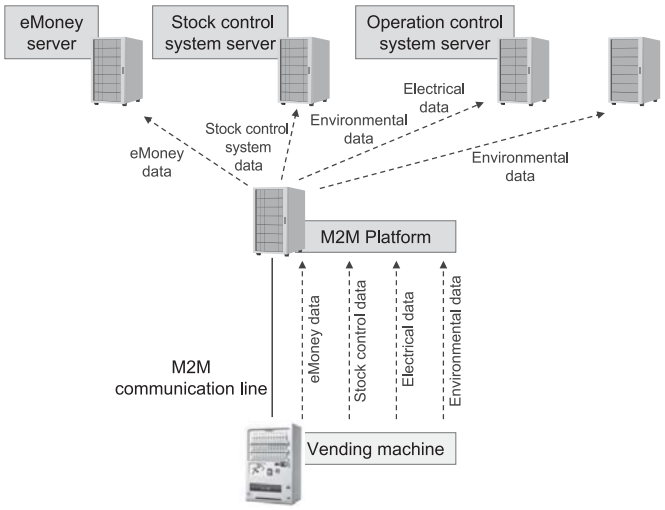

Fig. 5 Using M2M platform in vending machines.

communication services, it is anticipated that a great number of communication services using the vending machine as infrastructure will come into use.

On the other hand, different services require different degrees of authenticity, frequency and performance for data processing. For instance, since eMoney has a direct relationship with real money, it is inexcusable for such data to be lost or stolen. By contrast, for environmental data, the ability to efficiently process enormous amounts of data takes precedence over authenticity. In order to apply the M2M platform to vending machines, it will be necessary to iron out issues such as these.

5. Conclusion

In this paper we overviewed the eMoney process for vending machines, and discussed the possibility of multiple vending machine communication services being consolidated on the M2M platform.

About 4 million vending machines exist in Japan today. As these vending machines begin connecting to the M2M platform and communication infrastructure, and various new communication services are added, the vending machine will gain an additional role to selling goods, that is, playing a role in society’s infrastructure itself. For these reasons, expectations

[*5] Fig. 5 shows a scenario where environmental data is utilized by multiple applications.

are high for the development and dissemination of the M2M platform.

*WAON is a registered trademark of AEON Co., Ltd.

*iD and FOMA are trademarks and/or registered trademarks of NTT DoCoMo, Inc.

*QUICPay is a non-contact IC payment service with post-paid system recommended by Mobile Payment Promotion Association.

*Edy is a brand name of a pre-paid eMoney service managed by bitWallet, Inc.

*Smartplus is a trademark and/or a registered trademark of Mitsubishi UFJ NICOS Co., Ltd.

*Visa Touch is a trademark and/or a registered trademark of VISA Inc.

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11) "uM router", NEC Magnus Communications http://necmagnus.jp/mvn/um.html

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