Development of EMV Level2 Middleware Implementing IC Credit System

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Abstract

Application of IC to credit cards has already entered the period of massive dissemination and compatibility with IC credit cards will be indispensable for POS systems in the retail industry where payments have been done mainly using magnetic credit cards. In the past, IC credit card services have been accompanied by problems in cost and system flexibility because they had to comply with the international specification known as EMV, which used certified payment-dedicated terminals. Recently, the authors have succeeded in implementing a function meeting EMV as software (middleware) instead of by hardware and have obtained certification of this method by EMV. This middleware makes it possible to implement IC credit card-compatible systems without using dedicated terminals. It is expected that the middleware will play a very important role in various forms of credit card payment situations that will be implemented in the future.

Keywords

IC credit card payment, EMV specifications, middleware, POS system

1. Introduction

The market penetration level of IC credit cards has been increasing every year since the application of IC to credit cards was decided by the Japan Credit Card Association in January 2000. This trend is accelerating as the illegal use and forgery of credit cards has recently become a social problem. It is expected that about 70% of the issued credit cards will be IC cards by 2007.

Payments using IC credit cards are done using dedicated IC credit card-compatible payment terminals. This is because the processing of IC credit cards requires high security and authentication of the terminal is essential for guaranteeing the security. On the other hand, the various situations in which a credit card payment is possible are widely diversified at present. Payments are not only made at the counters of stores but are also done in many corners of stores as well as outdoors or even at home. As a result of this diversification in settlement locations the necessity for dedicated terminals has recently become an obstacle to achieving a smooth payment system for the use of IC credit cards.

In order to respond to this diversification, we have recently extracted the core part of the payment process and have implemented it as universally applicable middleware. This middleware makes it possible to achieve IC credit card processing relatively easily, using various types of equipment and terminals and without obtaining special terminal approvals.

2. Application of IC to Credit Cards and EMV Specification

Fig. 1 shows a simplified view of the structure of specifications for the IC credit card payment service. Each IC credit card should comply with the ISO (International Organization for Standardization) standard and, in addition, it should also comply with the EMV* specifications so that it can be compatible with the IC credit card payment service.

EMV improves the security against illegal use of cards in the credit transactions by checking credit cards with encryption keys and causing mutual authentication between card and terminal while maintaining the mutual operability between the IC card and terminal. At present, the standardization of EMV specifications, management and terminal approval are in charge of an organization called EMVCo.

The EMV Specifications include the EMV Level 1 and EMV Level 2 specifications, which are outlined separately in the following:

(1) EMV Level 1

This is the specification for ensuring the compatibility of IC card readers.

*The EMV Specifications are the unified standards for the IC card, agreed upon by international credit card issues including the then EuroPay (currently Mastercard International), Mastercard International of the USA and Visa International. The specifications were named "EMV" after the initials of the three companies.

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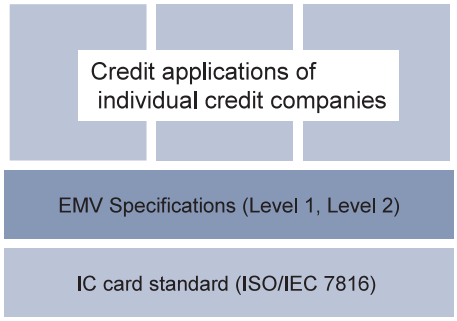

Fig. 1 Structure of specifications for the IC credit card payment service.

It prescribes the physical and electrical specifications such as the contact pressure of the IC card reader brought into contact with the IC card, the voltage supplied to the card reader, and the signal waveforms, as well as the normal communication protocols.

(2) EMV Level 2

The IC chip on the IC credit card includes the credit application of each credit card company. This specification prescribes the details and methods of processing for launching the credit application and performing the credit transaction.

3. System Configuration for the Implementation of IC Credit Card Processing (Traditional system)

Fig. 2 shows the traditional system configuration used for the IC credit card processing. The hardware of this system is composed of the following three units or of the two units other than ①.

① **POS (Point Of Sales) Terminal**

This unit sends the information on the paid sum to the payment terminal.

② **IC Credit Pin Pad**

This unit is composed of the card reader/writer for use in exchanging data with IC credit cards and the pin pad for use in the entry of code numbers.

It should comply with the EMV Level 1 Specification and be approved by EMVCo.

③ **Main IC Credit Card Payment Terminal**

This unit processes the payment of the paid sum information received from the POS terminal, and also executes the offline or online payment processing using the data stored in IC cards and the code number data received from the IC credit pin pad. When online processing is performed, it communicates with the CAFIS* or credit center to complete the authentication. The main terminal should be compliant to the EMV Level 2 Specification and be approved by EMVCo.

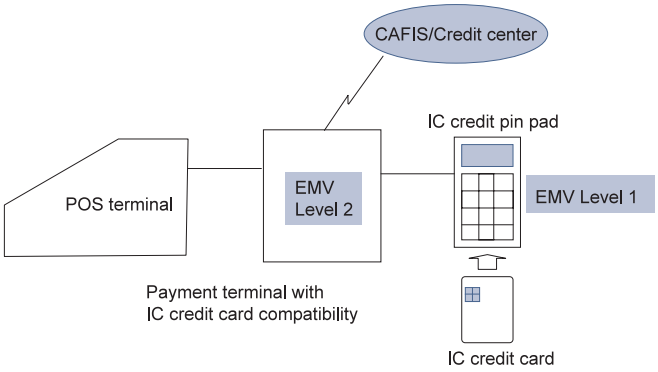

Fig. 2 System configuration for the implementation of IC credit processing.

4. A System That Does Not Need Payment-Dedicated Terminals

The traditional configuration as shown in Fig. 2 has been inconvenient for use in a limited space such as at the counter of a store and its high system costs have hindered its introduction in stores.

The authors have been studying methods for eliminating the payment-dedicated terminals from the IC credit card payment system and have recently succeeded in developing such a system, which is outlined in the following (also see **Fig. 3**).

- We implemented EMV Level 2 at the software level, com-

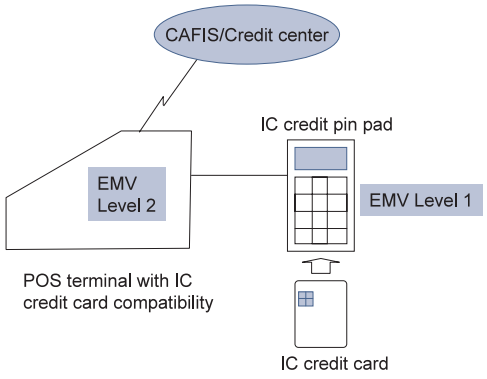

Fig. 3 System that does not need settlement-specialized terminals.

*CAFIS (Credit And Finance Information Switching system): Online credit information service provided by the NTT Data Corporation. It connects the credit card company and member stores through communications circuits in order to allow checking the payment limit, card validity, etc.

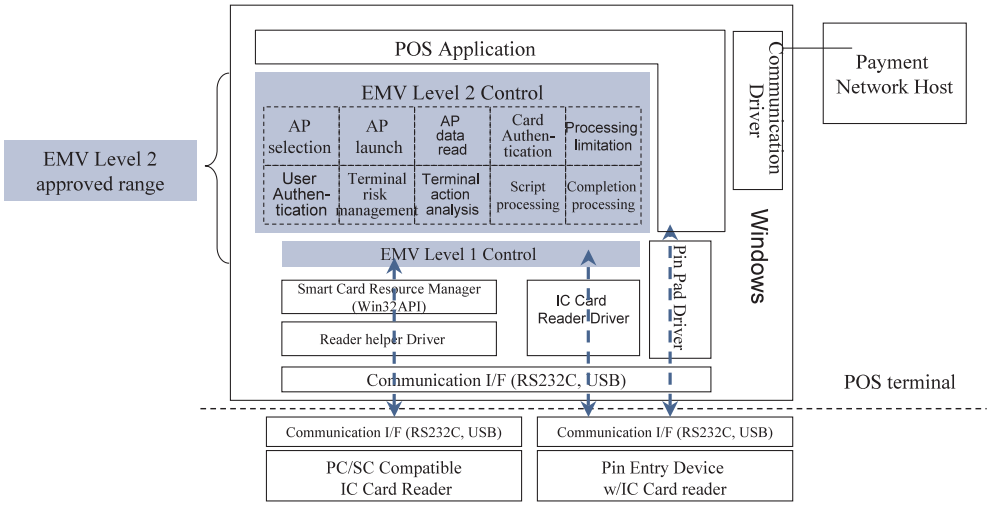

Fig. 4 Software structure for the POS system implementing the IC credit function using EMV Level 2 middleware.

piled middleware and obtained EMVCo approval. The approval number was as follows:

EMVCo Approval Number: 2-00845-1-1-TUV-1105

On this occasion, we used Windows as the OS and developed the system in the form of middleware running on Windows.

- We actually created an IC credit card processing method without using a payment-dedicated terminal by installing the EMV Level 2 middleware on Windows machines, including POS terminals and by connecting an IC credit pin pad that has been approved to meet EMV Level 1.

5. EMV Level 2 Middleware

Fig. 4 shows the structure of POS software for implementing the IC credit card function using the EMV Level 2 middleware.

The EMV Level 2 middleware is located between the IC card driver/pin pad driver and the POS application. It authenticates the cards and users based on the information in the IC cards and that input through the pin pad, executes the credit processing as defined by the EMV Level 2 Specification, and exchanges required information with the POS application.

6. Example of System Configuration Using EMV Level 2 Middleware

In addition to the configuration in which the EMV Level 2 middleware is packaged in the POS terminals as shown in Fig. 3, a system configuration as shown in **Fig. 5** is also possible. The system in Fig. 5 includes multiple POS terminals with EMV Level 1 pin pads connecting them, and a store server managing the POS terminals, and the EMV Level 2 middleware is installed in the store server. The store server collects the required information entered in the pin pads through the POS terminals, executes processing such as authentications and exchanges information with the CAFIS/Credit center as required. As this system requires each POS terminal only to send the pin pad-entered data to the store server through the LAN, the terminals can be simplified in terms of hardware resource, expanding the range of the terminal selections.

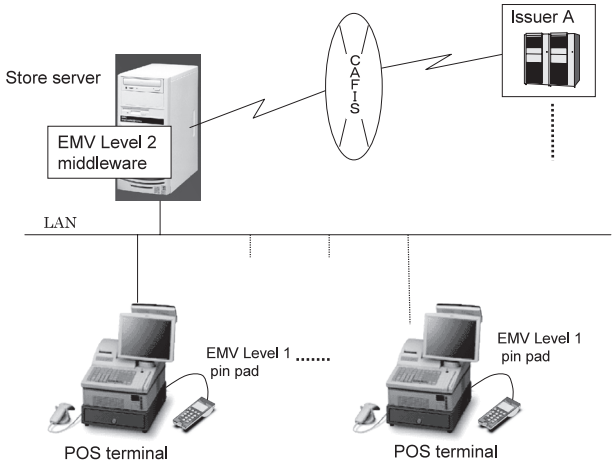

Fig. 5 System configuration example (1).

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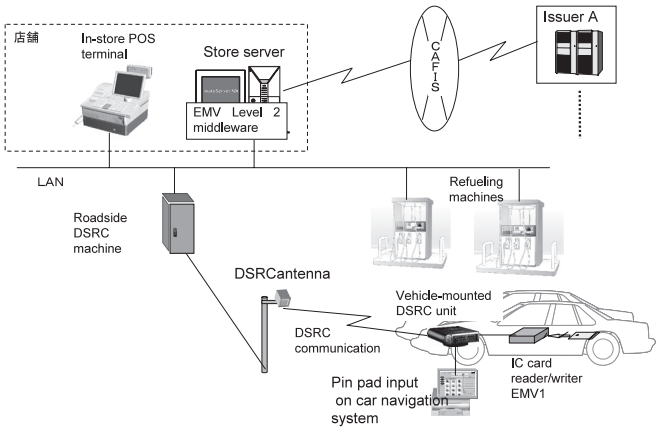

Fig. 6 System configuration example (2).

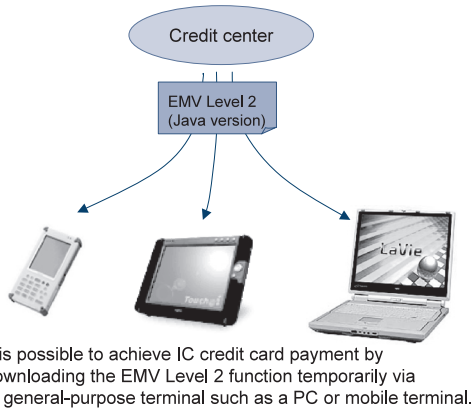

Fig. 7 System configuration example which can be realized in future.

Fig. 6 shows an application of the above system. This is an example of the "IC Credit Card Payment System Using DSRC (Dedicated Short Range Communication)," which is being subjected to demonstrative tests in gasoline stations, etc. In this system, the IC credit pin pad is installed in the vehicle, while the EMV Level 2 middleware is in the store server of the gas station. The pin pad and store server communicates through the DSRC to achieve the IC credit card payment. This application shows that the use of the EMV Level 2 middleware can make the configuration of IC credit card payment systems quite flexible.

7. Future Perspective

It is expected that the recent diversification in payment scenarios will increase the necessity of safer credit card payment using PCs, mobile terminals and cellular phones.

For the present the middleware should be run on Windows hardware because it has been developed on the Windows platform. However, if the same middleware can be developed on other platforms such as Java, for example, it will be possible to make use of the features of Java and create other forms of operation as shown below.

In the system shown in **Fig. 7**, when the terminal needs to perform payment using an IC credit card, it can download the EMV Level 2 middleware from the credit center, through the network, in order to perform it (provided that the terminal has an EMV Level 1-compatible pin pad).

As shown in this example, the future potential can be expanded further when the middleware is implemented on OSs other than Windows.

8. Conclusion

It has previously been regarded that the EMV approval for IC credit card payment should be obtained on a per-terminal basis. However, as a result of the development of the EMV Level 2 middleware and its EMV approval in November 2005, it is now not necessary to obtain the approval of each terminal provided that this middleware is used. We believe that the usability of this middleware will increase further as the scenarios of IC credit card payments become more diversified in the future.

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*Java is a trademark or registered trademark of Sun Microsystems, Inc. in the USA and other countries.

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